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CHARLES LANE POOR

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The Academy will meet on Monday evenings at 8.15 o'clock, from October 1st to May 27th, in the rooms of the American Society of Mechanical Engineers, at **12 West 31st Street.**

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Volume XIII

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Editor:
CHARLES LANE POOR

Acting Editor:
THEODORE G. WHITE

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[ANNALS N. Y. ACAD. SCI., Vol. XIII, No. 3, pp. 361-380, Jan. 12, 1901.]

THE SECTION AT SCHOHARIE, N. Y.

JOHN J. STEVENSON

(Read October 16, 1899)

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INTRODUCTION

The Schoharie River rises on the easterly side of the Catskill mountains, flows westwardly across the rugged area, then turns northwardly and finally enters the Mohawk river near Amsterdam, about one hundred miles from its source. It cuts the Helderberg escarpment at little more than a mile below the village of Schoharie in the county of the same name.

The Helderbergs are practically the northwestern border of the mountainous synclinal area known as the Catskills, the southeasterly border being the Shawangunk mountains. The section shown in the wall, as seen for many miles along the Delaware and Hudson railway, extends from the Hudson to the Hamilton, while the Chemung is reached at from one to four miles from the escarpment's edge. The succession is shown in such detail at many places that this Helderberg scarp from near

Albany to Sharon Springs has always been a favorite ground for students. Prof. James Hall made his first journey along its face in 1832 and three generations of Gebhards have followed him as industrious collectors along the Schoharie and its tributaries. Recent studies have been made by Prof. C. S. Prosser and Mr. N. H. Darton, which have gone far toward removing uncertainty respecting the relations of some of the beds.

Schoharie Valley is a broad indentation of the Helderbergs extending without material contraction for about five miles above Schoharie village. At that distance, however, the Marcellus has passed under the stream, and the hard beds of the Hamilton form the walls of the valley. The writer's study was confined to the immediate vicinity of Schoharie village, where, on both sides of the valley, the section extends from the Hudson to the Corniferous, while the Hamilton can be reached at barely a mile away. The object of the study was to compare the section below the Corniferous with that in south-central Pennsylvania. Many details were obtained during the examination, which are given here for the use of collectors who may visit the locality.

THE HUDSON, MEDINA AND CLINTON

The **Hudson** is represented indifferently at Schoharie, the exposures on the west side near the bridge and near the edge of the escarpment as well as the outcroppings along the east side of the valley north from the village being insignificant. But the beds are better shown along the Delaware and Hudson railway from Central Bridge to Esperance in this county where they are grayish to drab shales and sandstones, making up the low rounded hills northwestward from the escarpment. The thickness is very great, for, according to Mr. Darton, a boring near Altamont showed it 3,480 feet.

The Medina is unrepresented, and the Oneida, so massive in the Shawangunk, is wanting. The Hudson is succeeded by a shale, which is well shown on the west side of the river at a little way above the bridge, but very imperfectly on the valley road and on the point of West mountain. This, regarded as the equivalent of the Clinton, is somewhat variable in color, weathers dirty white and contains much nodular pyrite accompanied by barite. The same characteristics appear at Howe s cave, five miles west from Schoharie. The pyrite was mined near Schoharie thirty years ago, but the venture proved unprofitable. The exposures at Schoharie are incomplete but the thickness cannot exceed thirty feet.

There is here a very striking contrast with the section of southern Pennsylvania and of other localities farther southward.

The Hudson shales, in Evitts mountain, Bedford county, Penn., mostly yellow in color, contain some sandstones near the top, where the color changes and physically there is a gradual passage to the lower or red Medina. *Rafinesquina alternata*, *Plectambonites sericea*, *Rhynchotrema capax* and *Leiopteria radiata* pass upward into the red Medina. The conditions in southwestern Virginia are the same. On the northern side of Big Walker mountain in Bland county, near Sharon Springs, as well as in Lyons gap through the same mountain in Smyth county and Hayter's gap through Clinch mountain in Russell county, exposures are especially good, as they show a fossiliferous bed at about one hundred feet below the white Medina, in which *Rhynchotrema capax*, *Actinopteria emacerata*, *Leiopteria radiata*, a *Modiolopsis* a large linguloid form and fragments of *Orthoceras* occur abundantly. The Oneida seems to disappear in south-central Pennsylvania and thence southward the passage from Ordovician to Silurian is gradual at most of the exposures.

THE NIAGARA

The **Niagara** limestone is represented by the Coralline limestone of the older reports, which, at the complete exposure on Schoharie river above the bridge, is a massive rock in three layers, averaging in all six feet. The upper portion is very dark on fresh surface, the lower portion less so, but both weather light gray. This limestone is well exposed along the west side of the river for an eighth of a mile above the bridge and at several points below the bridge; it can be followed easily to Howe's cave, where it underlies the "Cement rock" of the Waterlime. The only exposure on the east side is that near the African church, but the rock is present along this hill northward and in the Foxkill valley eastward, as the stone fences hold fragments of it in abundance. Some portions are crowded with *Favosites niagarensis* and *Stromatopora concentrica* but other forms are rare. Occasionally one finds a nest of *Rhynchonella lamellosa* with *Atrypa reticularis* and *Pterinea securiformis*, all well preserved. Besides these are some univalves and cephalopods but for the most part they are indefinite and in some cases even the genus cannot be determined satisfactorily.

THE ONONDAGA

The **Onondaga,** of Dana, is represented only by the **Waterlime.** The Salina shales, so thick in western New York and persistent in southward even to the Baltimore and Ohio railroad[1] in Maryland, have no representative here. The physical change from Coralline (Niagara) to Waterlime is sufficiently sharp in that the color changes abruptly from very dark brown (the "blackrock" of the Cement quarries) to dark gray or dull brown while the fracture becomes more earthy and ragged, though the weathered surface of the two rocks is very similar.

The **Waterlime** is not well exposed at any point near Schoharie. The space between the Coralline and the Tentaculite on the east side is apparently not more than 15 feet, but it is certainly greater on the west side of the river upon the Gebhard farm, where there is a good exposure for more than six feet above the Coralline. The succession is fairly well shown at the Howe's cave cement tunnel, where, in descending from the Tentaculite limestone, one finds

1. Flaggy and shaly limestone.	31′
2. "Blue rock"	2′ 6″
3. "Cement rock".	6′
In all	39′ 6″

---

[1] As ascertained by I. C. White.

The upper portion of No. 1 is shown at the entrance to Howe's cave, and at the grinding mill as well as in an excavation near by once occupied by a kiln. The middle portion for about 6′ is concealed, while the lower portion is exposed at the tunnel. The flaggy layers are from 6″ to 1′ thick and hard, yielding a good building stone, which was used in the older part of the Cave hotel. The greater part of the mass, however, is made up of layers from one to two inches thick, separated by laminæ of shale. The rock weathers light gray with trace of blue, but is brownish gray on the fresh surface. The "blue rock" is evidently a hydraulic limestone, light blue in color, with irregular fracture and too calcareous for cement. The "cement rock," which forms the base of the mass, varies little from 6′ and is in three layers. It is darker than the last, more ragged in fracture and is the cement rock of the works in Ulster and Schoharie counties.

At Howe's cave, calcite occurs in little patches between the "Blue" and "Cement," sometimes in sufficient quantity to be annoying. Near Schoharie, it has been obtained at Clarke's cave as well as near the Table rock, both on the west side of the river. Near the latter locality, strontianite is associated with the calcite. Several tons of the former mineral were shipped, but the deposit did not prove to be of economic importance as the streaks are too variable. No attempt has been made at Schoharie to utilize the rock in the manufacture of cement, though the character is apparently the same as at Howe's cave, where preparations are making for an output of 2,000 barrels per diem.

While the color and composition of the rock prove a decided change in physical conditions from those prevailing during the Niagara, still that change must have been comparatively unimportant, since it did not suffice to cause local destruction of the fauna. At Howe's cave, *Favosites niagarensis* passes upward from the Coralline and persists in the lower three feet of the "cement," being so abundant in some of the headings as to unfit the rock for use. According to Professor Hall, *Halysites catenularia* passes from Niagara to Waterlime in Herkimer county. At Schoharie, Mr. W. D. Gebhard has obtained some of his best

"Coralline" forms from the lower layers of the Waterlime; and certainly some specimens in the New York University museum, collected many years ago by John Gebhard, Jr., are in rock showing the color and fracture not of Coralline but of Waterlime. It is sufficiently evident that, while the great mass of Salina shale was in process of deposit in central New York and in much of the Appalachian region, the conditions within this portion of New York changed so gradually as to bring about only a slow disappearance of the fauna. There is a steady increase of calcareous matter from the bottom to the top of the Waterlime. No fossils were found in the lower portions of No. 1, but, above the middle, *Spirifer vanuxemi* and *Leperditia alta* were obtained from the thicker layers, showing that the passage to Helderberg was quite as gradual as that from Niagara.

The Waterlime is the cave rock of this region.

THE HELDERBERG

The Helderberg (**Lower Helderberg**) was divided by the older geologists into

1. **Tentaculite Limestone.**
2. **Lower Pentamerus Limestone.**
3. **Catskill or Delthyris Shaly Limestone.**
4. **Scutella Limestone.**
5. **Upper Pentamerus Limestone.**

The succession being in ascending order.

This succession is distinct in southern Pennsylvania and even in southwest Virginia, though in the latter area the upper beds are quite silicious. The formation is termed the Lewistown limestone in the Pennsylvania reports.

1. The Tentaculite Limestone

The passage from **Waterlime to Tentaculite** is marked in the Schoharie region by an abrupt change in color, the latter being the "Blue limestone," with blue so deep in the lower layers as to appear almost black. The succession in descending order is

Tentaculite limestone.

1.	Limestone, bluish, irregularly bedded, layers 2″ to 4″ thick	2′ 6″
2.	Limestone, bluish, irregularly bedded, often sub-concretionary, the layers separated by very thin shales	13′ 6″
3.	Limestone, deep blue, in two layers, 2′ 3″ and 2′ 6″, separated by 2″ of clay, massive, brittle, conchoidal fracture, fetid odor	4′ 11″
4.	Limestone, thin layers with laminæ of shale	5′
5.	Limestone, blue to bluish-black, massive	2′ 5″
6.	Limestone, bluish, irregular, sub-concretionary structure	2′
7.	Limestone, thin bedded, with laminæ of shale	5′ 8″
8.	Limestone, in layers about 1″ thick	1′
9.	Limestone, bluish-black, ragged fracture, massive, in three layers	8′ 5″

in all 45′ 5″ thick.

This section is seen in an almost continuous exposure on the east side, where quarries have been worked for a quarter of a mile below Schoharie village, and there are many partial exposures within half a mile above the village. The only complete exposure on the west side is along the road ascending West Mountain. Occasional outcrops were seen on Foxkill and Cobleskill east and west from the Schoharie and the great quarries at Howe's cave exhibit the same order. At one time, the massive beds were quarried either for building or for ornamental stone, but they are used no longer, as planes of bedding developed on exposure and caused unsightly seams. The weathered surfaces in the quarries show that the massive beds are laminated though the surface of fresh fracture shows no trace of such structure.

The lowest bed was quarried most extensively as it yields blocks of large size. The rock is brittle, rings when struck but has a very ragged fracture. Fossils are comparatively rare, only *Spirifer venuxemi* and *Leperditia alta* having been seen. But the half-burned rock is clearly a mass of fossils, mostly of the forms mentioned with some *Tentaculites.* No. 8 varies little in thickness and not at all in character. The upper surfaces of the layers are crowded with *Tentaculites gyracanthus*, which at many localities are in perfect condition. No. 7 is more irregular in its bedding. Thin laminæ of limestones in the shales separating the thicker layers are crowded with fossils, seldom in good condition. The predominating forms are *Zaphrentis*, *Stromatopora*, *Spirifer vanuxemi*, *Leiopteria aviculoidea*, *Tentaculites gyracanthus*, *Leperditia alta*, *Beyrichia* and minute univalves. The delicate crinoid, *Homocrinus scoparius*, is said by W. D. Gebhard to belong in the upper portion of this division, but no fragments of it were found. No. 6 contains many *Stromatopora*, some of which are large, one colony having been seen which weighed more than 75 pounds. No. 4 resembles No. 7 and contains the same fossils in the same condition. No. 3 resembles Nos. 5 and 9. It yields the *Spirifer* and *Leiopteria* well preserved but *Tentaculites* is rare. No. 2 is very fossiliferous, and the specimens obtained from the harder parts are very good; *Stropheodonta varistriata* occurs abundantly and a fine pygidium of *Dalmanites micrurus* was found near the top. No. 1 contains few fossils aside from fragments of crinoidal stems, which are shown on the weathered surface. Besides the forms mentioned, some of the massive beds contain *Orthoceras;* no specimens were found in place but several were obtained from the waste piles. Irregular markings occur on the surfaces of the higher beds which may be looked upon as mats of fucoids, shrinkage cracks or trails; all appear to be chafed or water-worn as though the rock had been at the water's edge.

There is no transition from the **Tentaculite** to the **Lower Pentamerus.** The former is blue, brittle, laminated or thin-bedded; the latter is bluish gray, massive, extremely tough and refractory. The best blocks of Tentaculite bear little strain; some, 15 inches thick, in the Schoharie cemetery have broken on irregular foundations under the weight of comparatively small monuments, but the Lower Pentamerus is reported to bear a pressure of 19,000 to 26,000 pounds to the square inch.

2. Lower Pentamerus Limestone

The **Lower Pentamerus** consists of 33 feet of hard, massive limestone below and 32 feet[1] of alternating hard and somewhat softer limestones above. The lower portion forms a bold cliff, which is distinct on both sides of the Schoharie valley to two miles above the village, where it passes under the river at less than half a mile below Davis's dam. It is equally distinct westwardly to Howe's cave and eastwardly along the face of the Helderberg for many miles. The rock is excessively hard, or better, tough, very difficult to break with the hammer. The bedding is evident, but there is a subordinate structure, so that the rock seems to be made up of irregular lenses separated by coatings of clay. This structure is very apparent on the weathered surface, and is recognizable without difficulty in the unweathered rock. The weathered surface is very irregular and suggests a loose structure, but in Mix & O'Reilly's quarry at Schoharie, building-stone of the best quality has been obtained at five feet back from the face. The rock has been exposed to attack from both sides in that quarry, for the joint planes have been converted into open fissures, whose sides are weathered as thoroughly as is the exposed cliff. The clay film may be a cementing material for the lenses. The color is dull grayish on the cliff face, which is often coated with drip lime, but internally the color has more of blue, though wholly different from the blue of the Tentaculite. The full thickness of this portion is not shown on the east side, but is exposed on the west side of the valley, along the road ascending West mountain. The character of this portion is the same as at Howe's cave, where, however, no use is made of the rock except in preparation of road metal.

The upper portion of the **Lower Pentamerus** is not exposed in satisfactory detail near Schoharie. An imperfect exposure was found in a dry waterway in the park back of Schoharie village on the east side, and another in a similar waterway on the west side, about 200 yards south from the schoolhouse.

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[1] These measurements are by barometer.

The succession at both places is that of thin limestones varying in hardness but with very little trace of shale. No exposures were seen in open fields on the east side, but the harder beds are shown on the schoolhouse hill south from the waterway just mentioned, where the decayed outcrop gives opportunity to see the fossils.

The toughness of the lower portion is such that fossils can be obtained in very few places; even where decay has gone on for a long period, the result is little more than mere separation of the lenses, leaving the limestone itself as refractory as before. A few layers, however, are more readily treated and yield numerous strophomenoid forms, one of them being evidently the *Stropheodonta* of the Tentaculite. *Sieberella galeata* is found abundantly with the valves separate. *Uncinulus mutabilis*, *Atrypa reticularis* are common; rude fragments of *Orthoceras* and pygidia of *Dalmanites* occur, and fragments of crinoidal stems are not rare. In the upper division the same forms are present, but the *Sieberella* is less common. A layer within two or three feet from the top is characterized by the *Lepadocrinus gebhardi*. A continuous outcrop of more than 200 feet in the field south from the schoolhouse shows the stems in great abundance, but complete specimens are very rare, barely a dozen examples having been obtained during almost seventy years of collecting by three generations of Gebhards. This horizon is exposed in the park near Schoharie village. One of the higher layers contains great numbers of *Mariacrinus* stems, some of which are more than a foot long.

3. The Delthyris or Catskill Shaly Limestone

The immediate contact between the Lower Pentamerus and the Delthyris was not seen, there being a concealed interval of from two to five feet between characteristic beds. The thickness of the Delthyris by barometer is from 85 to 95 feet. The mass is a succession of limestone beds, one to three feet thick separated by beds of calcareous shale varying in like manner. The limestones are bluish to dark gray, some of them very light gray. Many of them are somewhat argillaceous and most of them weather light gray. The shales are hard but weather readily. As a whole the rocks wear away easily so that the place of the Delthyris is marked by a slope between cliffs made by the Lower and the Upper Pentamerus. This slope on the east side of the valley is long and gentle so as to be cultivated and there are few satisfactory exposures; but the slope is comparatively steep on the west side and an almost continuous exposure is found on the schoolhouse hill in a little waterway. Imperfect exposures only were found on West mountain near Murphy's, though there one finds the best exhibition of the uppermost beds. The most extensive exposure is on the west side of Schoharie river below Davis's dam, where one sees all the beds, except the topmost, as they descend to the river; when the water is low, a horizontal space of 25 to 100 feet is bare.

The lower portion for about fifteen feet is silicious and contains much chert. It is shown on the schoolhouse hill where it can be followed for a long distance; but a proper understanding of the structure of this portion can be gained only at the Davis dam locality, where the broad surface shows the interlacing of the cherty masses. The fossils in this part are numerous and beautifully preserved; they are all silicified but cannot be removed except by weathering. The rock is refractory and is apt to break at the wrong place for the collector. The highest beds are soft calcareous shales best shown on West mountain at the Murphy place, where for a hundred feet or more they have rotted away leaving a recess under the Scutella-Pentamerus cliff.

The **Delthyris** is fossiliferous throughout and in many of the beds perfect specimens are the ordinary condition. Owing to the readiness with which the softer beds weather, specimens are set free in great number. Some forms are present throughout. At Davis' dam *Spirifer macropleura* makes its appearance in the cherty beds and persists to the top of the series. It was not found in the highest shales at the Murphy locality. *Atrypina imbricata* and *Coelospira concava* are rare in the upper shales though abundant in the beds below. The most characteristic forms occurring throughout the Delthyris are *Zaph-*

rentis helderbergiæ, *Leptæna rhomboidalis*, *Stropheodonta beckii*, *Orthothetes woolworthana*, *Rhipidomella oblata*, *Dalmanella subcarinata*, *Spirifer macropleura*, *S. cyclopterus*, *S. perlamellosus*, *Meristella arcuata*, *Eatonia medialis*, *Stenochisma formosa*, *Uncinulus nucleolatus*, *Platyceras elongatum*, *Phacops logani*, *Dalmanites* and *Lichas* in fragments. *Orthoceras* fragments are many but obscure.

4. The Scutella Limestone

Resting upon the shales closing the Delthyris is a limestone, eight feet thick, light blue, slightly granular and containing vast numbers of crinoidal stems, whose white color contrasts markedly with the blue of the rock. For two feet at the bottom this **Scutella limestone** is in layers one to two inches thick, but, above, it becomes more nearly massive. It forms the lower part of the upper limestone cliff, which stands out on both sides of the valley to a short distance above Davis' dam, about two miles and a half above Schoharie village. This cliff is less conspicuous than that below, as the rock is less resistant, but its place is distinct. The most notable fossils are the shield-like bodies of *Aspidocrinus scutelliformis*, which in some cases are almost three inches in diameter. The stems accompanying them are from one-fifth to one-third of an inch in diameter, but they can hardly belong to *Scutella*, as in that form the pit for attachment is very small. Other fossils are abundant, most of them forms which are found in the Delthyris. The brachiopods, except *Atrypa reticulatus*, usually have the valves separated.

5. The Upper Pentamerus Limestone

This has been united by Professor Hall with the Scutella under the name of Becraft limestone, as the two limestones appear to be hardly distinct enough in some other localities to deserve separate names. In the Schoharie area, however, they are easily distinguished by the color of the fresh surface, although the weathered surface shows no difference. The Upper Pentamerus forms the upper portion of the second cliff on both sides of the valley and can be reached at many places up to its disappearance above Davis' dam. The color is bluish gray, much darker than that of the Scutella but much lighter than that of the Lower Pentamerus. Like the latter, it is somewhat irregular and roughly lenticular in structure, but less so. The upper layers are easily broken and resemble the Scutella in color as well as in general appearance. They are crinoidal and carry *Zaphrentis* almost to the top, where they seem to contain little more silica than the lower beds. These upper layers include some thin shaly beds, thus differing from the lower portion, which at most localities is rather massive. The thickness as measured on the schoolhouse hill is approximately 22 feet. Exposures on the east side of the valley are not complete, only the lower portion being shown at most localities. Erosion on that side both before and during the glacial period was much more extensive than on the west side. Good measurements can be obtained on the Schoolhouse hill and on West mountain, both on the west side.

The **Upper Pentamerus** is richly fossiliferous ; in some layers only separated valves even of Atrypa and Rhynchonelloid forms can be obtained, but in others the specimens are well preserved and abundant. Some forms are present throughout ; *Leptæna rhomboidalis*, *Schizophoria multistriata*, *Spirifer concinnus*, *Meristella princeps*, *Atrypa reticularis*, *Wilsonia ventricosa*, *Stenochisma formosa*, *Uncinulus nobilis*, *Sieberella pseudogaleata* ; but beside these are many forms, the writer having obtained *Rensselæria*, 2 sp. ; *Rhynchonelloid* forms, 4 ; *Meristella*, 3 sp.; *Spirifer*, with *Orthis*, *Leptæna*, *Stropheodonta*, *Platyceras*, *Orthoceras*, *Trochoceras*, *Favosites*, *Chætetes*, *Stromatopora* and *Lichenalia*. The *Favosites helderbergiæ* is most abundant about midway and is often associated with chert. Where the rock is in proper condition, as at the Brown farm northeast from Schoharie and above Davis's dam, the Upper Pentamerus affords a series of fossils as interesting and as well preserved as those of the Delthyris. Specimens rarely weather free in good condition as they are not silicified, but the limestone is much more tractable than the Delthyris and specimens can be broken from the rock, almost as good as those of the Delthyris.

THE ORISKANY SANDSTONE

The **Oriskany** is thin at Schoharie, not more than ten feet. The contact with Upper Pentamerus was not seen but on the schoolhouse hill and on West mountain the concealed space is not more than 18 inches. The rock is rarely found in place as it decays readily and the crop becomes covered. One exposure on the schoolhouse hill shows 7 feet. On West mountain the interval from the highest observed layer of the Pentamerus to the top of the Oriskany is barely 12 feet. The rock is bluish gray, slightly calcareous sandstone with much ferruginous matter as cementing material. Unweathered, it is very hard, but weathered it is rusty yellow and very tender.

The change from Helderberg to Oriskany is abrupt at Schoharie and according to Mr. Darton's observations it seems to be equally so throughout the region. Professor Hall once stated in conversation that the break at this horizon is one of the best defined in the State of New York. But the case is different farther south in the Appalachian region. The transition is very gradual in southern Pennsylvania, there being as the transition bed a silicious limestone, 20 feet thick, very cherty, whose whitened fragments occur abundantly on every **Oriskany** ridge in Bedford county. This bed contains the Helderberg *Favosites* along with such typical Oriskany forms as *Spirifer arenosus* and *Platyostoma ventricosum*. The section is almost complete at Hyndman, where the quarries are extensive. This transition bed is persistent southward, being present as the attenuated representative of the Oriskany and Helderberg at several localities in the Valley of Virginia, where those formations thinned out against the old shore-line. The intimate relation between these formations seen in southern Pennsylvania is equally clear in southwestern Virginia, where, however, the Helderberg becomes silicious in the upper portion and the Oriskany contains so many Helderberg forms that the writer during his first examination of the region thought it the Helderberg. In New York the Oriskany does not contain crinoids, but such forms are by no means rare in Maryland and southward.

Fossils abound in some layers of the **Oriskany**. They are not obtained readily from unweathered rock and the weathered rock affords usually only casts, which, however, show the interior structure with extreme accuracy. Sometimes where the decay has not caused complete removal of calcareous matter, exquisite specimens are found, showing shell structure and internal appendages of brachiopods. The forms are not numerous at Schoharie, but many of them are such as to be attractive museum specimens. Those commonly obtained are *Spirifer arenosus*, *S. arrectus*, *Metaplasia pyxidata*, *Meristella lata*, *Rensselæria ovoides*, *Megalanteris ovalis*, *Rhipidomella musculosa*, *Eatonia singularis*, *Stropheodonta magnifica*, *Hipparionyx proximus*, *Anoplotheca flabellites*, *Platyostoma ventricosum*.

Lamellibranchs are not rare, but they are seldom obtained in good condition. The only forms passing up from the Helderberg are the *Eatonia* and *Leptæna rhomboidalis*, the latter very rare.

THE CORNIFEROUS

Everywhere throughout this region there rests upon the Oriskany a mass of shale, grayish, from 95 to 105 feet thick (by barometer). This is the **Cauda Galli grit**, the **Esopus shales** of Darton, and forms the slope above the Upper Pentamerus cliff on both sides of the Schoharie valley. Its bottom layer, 3 to 5 inches, is hard and forms the floor of the bench, protecting the softer Oriskany, whose wasting has formed a subordinate slope Much of the shale is fissile, this being shown on West mountain where the slope is abrupt; the upper portion is rather harder and is jointed so as to come out in blocks, 3 or 4 feet by about 2 feet and 8 to 12 inches thick. The *Spirophyton* is most abundant in the upper part. The exposures near Schoharie are all imperfect, the best being on West mountain: there are very few on the east side where the pre-glacial erosion was very extensive.

The **Schoharie Grit**, between the Cauda-Galli and the Corniferous limestone, is rarely more than 6 feet thick and is exposed at very few localities. It is an excessively hard silicious limestone, containing much ferruginous matter and dark brown on the fresh surface. Weathered, it resembles the Oriskany, but is darker. It is so hard as to suggest that silica is the cementing material. But the iron leads to disintegration and the rock wastes away, so that its outcrop is concealed by heavy blocks of Corniferous, between which debris has accumulated. The only outcrop discovered is on the northwest face of West mountain, but the presence of the rock is shown on both sides of the valley by the fragments strewn about the fields. The unweathered rock is so hard as to yield nothing to the collector, but several layers are extraordinarily rich in individuals of a few types, which can be procured easily from weathered fragments. The ordinary forms belong to *Stropheodonta*, *Pentamerella*, *Atrypa*, *Orthoceras*, *Cyrtoceras*, *Trochoceras* and *Gomphoceras*. Cephalopods are the prevalent forms. *Atrypa reticularis* is the most common of the brachiopods and its casts as well as those of *Stropheodonta* are in admirable condition for study.

The **Corniferous** limestone caps West mountain and the schoolhouse hill on the west side of the valley and is easily followed to where it passes under the river near Borst's dam, about four miles above Schoharie. It is quarried extensively at the lime-kilns below the dam. It is imperfectly shown on the east side at several places within two miles and a half above Schoharie village, but, above that, the valley is eroded in Cauda-Galli and the bluff is covered with debris from the Hamilton. The Corniferous is known as the "Top gray limestone." It is gray, brittle and contains much chert in lenses and irregular layers. The older geologists divided it into Onondaga and Corniferous, but chert appears to be characteristic of both divisions and the older name should be applied to the whole. The thickness in schoolhouse hill is not far from 30 feet but it is greater at the limekilns where the whole is shown. Fossils are abundant but only a few forms are likely to be obtained by the collector. Cyathophylloid corals, *Favosites* and *Syringopora* are the characteristic types; *Gyroceras trivolvis* is obtained occasionally at the limekilns; *Atrypa reticularis* attains large size as it does also in the same limestone further west in this State. Some of the layers contain many trilobites.

THE HAMILTON

The Hamilton is reached on the west side at little more than a mile above Schoharie, while on the east side it caps the hill at about the same distance east from Schoharie. The Marcellus with its Goniatite limestone comes down to the river at Middleburg, five miles above Schoharie, where the Hamilton sandstones form a bold cliff. The shales contain *Liorhynchus limitaris* in profusion while the limestone is rich in *Goniatites*, *Orthoceras* and *Nautilus*. The Hamilton sandstones have yielded many species of lamellibranchs. No measurements of these beds were made.

LOCALITIES FOR COLLECTORS

The impression prevails that as the Schoharie region has been a collecting ground for three-fourths of a century, it must be practically exhausted ; but this is wholly erroneous. It is quite true that weathered specimens free from the rock are no longer to be had plentifully but the writer discovered that the old localities repay careful work as well as they did thirty years ago, when he first collected there.

The **Coralline** limestone is well shown near the African church in Schoharie and fragments of the rock in excellent condition are plentiful in stone fences along the lower road leading northward from the village.

The **Tentaculite** is fully exposed in the long line of old quarries from the cemetery northward, in all of which the waste piles are very large. The *Tentaculites* are in best condition in an old quarry at the south end of the village.

The **Lower Pentamerus** cliff is broken at several places between the cemetery and the point where it crosses the Middleburg road, less than a mile south from Schoharie, and it is quarried extensively just north from the village. The upper layers are shown on the west side in a field barely one-fourth of a mile south from the schoolhouse.

The **Delthyris** gives good returns on the road leading to Mr. Brown's house, northeast from the village ; in a watercourse near the schoolhouse on the west side, and especially in the long exposure on the west side of the river below Davis's dam; the topmost shaly beds are best reached under the Upper Pentamerus cliff on the Murphy farm, West mountain.

The **Scutella** is available on the Brown property, at the upper side of the "Gallows field" and on Stony run, all on the east side; at Murphy's and the schoolhouse hill on the west side.

The **Upper Pentamerus** is well shown and easily worked on the Brown property, and especially at the "Rocks" above Davis's dam, on the east side; while the exposure on the schoolhouse hill on the west side is especially good, as the individual layers are exposed over a broad space.

The **Oriskany** is best on the schoolhouse hill where large weathered fragments occur along a line of more than a quarter of a mile. But one needs heavy tools here, as the smaller fragments have been utilized.

The **Schoharie** grit can be found on the northwest side of West mountain and in the fences on the east side along Stony brook. The best localities for **Corniferous** are on West mountain, schoolhouse hill and the limekilns.

As a locality for study of simple stratigraphy, preliminary to the study of more complicated structure such as that of Kingston and Rondout, the Schoharie valley is unexcelled, and it is to be commended to the attention of instructors in field geology.

APPENDIX

Glacial Action in Schoharie Valley

Archibald E. Stevenson

The hills on each side of Schoharie valley rise about 500 feet above the river. The slopes on the western side are very steep, even those of the Delthyris and Caudi Galli being climbed with some difficulty; but the slopes on the eastern side, with the exception of the Pentamerus cliffs, are so gentle that they are cultivated.

Above Schoharie the contrast is not so strong, for there cultivated benches are seen also on the west side. For the most part, the river runs near the foot of the western hills. The valley contracts at five miles above Schoharie, where it is enclosed in the harder rocks of the Devonian.

Messrs. Mix and O'Reilly recently opened a quarry at a little north from Schoharie, where the stripping exposed a glaciated surface of the Lower Pentamerus, and showed well the character of the till.

The striæ are shallow, some as slight as though they had been made with a pin. The strongest scratches are not more than 1/20 of an inch deep, and 1/10 of an inch wide. The general surface is highly polished. The striæ appear to be in two systems, the stronger of which varies from N. 55° E. to N. 73° E., the most marked running N. 66° E. The other is not so strong, its striæ varying three or four degrees north or south of east.

An interesting feature of the surface in this quarry is the occurrence of two abrupt steps, one about 2½ feet high, running N. 45° E., and the other, not so high, N. 66° E. These must have existed before the ice invasion, as the former is but slightly rounded at the upper edge, while the face is unpolished, whereas the face of the latter is highly polished.

The extreme thickness of till shown is ten feet; the bowlders are large in the lower part, often two feet in diameter, but decrease in size toward the top, where they are mere pebbles of two or three inches. They are of foreign material, the large ones being gneiss, while very many of the smaller ones are apparently from the Hudson shales, which are exposed within a mile or so northward; all are more or less water-worn.

The clay is slightly calcareous, and small stalactitic deposits are frequently found in its cavities. This till was followed up the valley to the old cemetery quarry, where it rests upon the Tentaculite limestone, which, also, is covered with striæ.

The Upper Pentamerus, on this side, at more than 100 feet further up the hill, shows also a glaciated surface on the Brown property with striæ following the same general directions as those on the Lower Pentamerus.

On the west side of the valley, a striated surface of Lower Pentamerus, corresponding to that on the east side, is reached at less than half a mile north from the bridge; while the till is shown at about the same distance south, on the Middleburgh road, where it makes a very cold soil. On this side an angular bowlder of much sheared gneiss, measuring 4 by 6 by 5 feet, was seen, at 370 feet (by barometer) above the river, on the Caudi Galli slope and near it another of gneiss, about half as large. Water-worn fragments of gneiss are scattered over the surface everywhere from the river to the hill tops, while angular fragments of transported rocks seem to be rare.

The distribution of the till and the direction of the striæ seem to show that the valley, as it now appears, has practically the same shape as before the ice invasion. The several benches of harder rock must have existed in the earlier time as now on the east side, where they are separated by the long gentle slopes of softer rocks; for, far back from the river, the Upper Pentamerus bench is scratched, while lower down and nearly one third of a mile nearer the river we have the Lower Pentamerus beautifully striated, while lower yet we have the benches of Tentaculite and Coralline well polished and covered with till. The cutting done by the ice must have been comparatively small; bowlders of Pentamerus and Tentaculite were not seen up the valley above the horizons of those rocks. This weakness in cutting is shown also by the peculiar form of the benches in Mix and O'Reilly's quarry.

NOTE.—Since this paper was read, Messrs. Clarke and Schuchert have published their scheme of the New York Series, in which are revived some of the older names, for which certain terms used in this paper will become synonyms. "Hudson" is synonymous with "Lorraine"; "Waterlime" is the "Rondout Waterlime" of Clarke and Schuchert; "Tentaculite" is synonymous with "Manlius" Vanuxem; "Lower Pentamerus" and "Delthyris" will be replaced by the newer terms "Coeymans" and "New Scotland" of Clarke and Schuchert.

November 22, 1900. J. J. S.

NEW YORK UNIVERSITY, NEW YORK CITY, October, 1899.

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NOTES ON PASSAMAQUODDY LITERATURE

J. Dyneley Prince

(Read February 24, 1899)

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SOURCE OF INFORMATION HEREIN PUBLISHED

Like the material previously published by the writer, pertaining to the wampum records (Prince, '8) and to the *Wabanaki* history (Prince '8), the following notes were gathered at Bar Harbor, Maine, from the Passamaquoddy Indians who spend the summer there. They have been arranged chiefly from papers prepared for me in Indian and English by Louis Mitchell, former member of the Maine Legislature for the Passamaquoddy tribe.

RECREATIONS OF THE PASSAMAQUODDY AND PENOBSCOT INDIANS

Story-telling. Recreation was never allowed among the Passamaquoddies and Penobscots except during the winter months when the deep snows made sport and war impossible. Perhaps the favorite amusement of the younger people was story-telling (*hookautin*), at which many of the old men and women were adepts. A group of young indians would often gather in a wigwam and listen with eager interest for hours to the protracted tales of some professional narrator (*notathooket*). A great number of these stories of love, war, and witchcraft still exist in the memories of older indians, and, as the tribe diminishes year by year, are bound to perish unless collected by those who feel an interest in the history of the aborigines of America.

EXAMPLE OF NARRATIVE. The following narration of constancy in a *Wabanaki* girl, which is, of course, much abridged from the original, is a fair specimen of their style.

Long ago in the village of Lusigantook,[1] there lived a beautiful maiden whose heart many a young man had tried in vain to win. Finally, however, she succumbed to the charms of a brave and successful young hunter, who had long been in love with her, and, in spite of the ill luck of his fellows, ventured to send to her the *nojiquetsettasit* or "old woman who carried proposals of marriage." Greatly to his delight, he received a favorable reply, and he accordingly determined, indian fashion, to win even greater fame as a hunter. He, therefore, told her that he would not marry her until he had gone on a hunt which should last two years. The girl agreed to his proposal and promised to remain true to him at all hazards, adding that even if he never returned she would stay single all her days, a vow which the young man echoed with equal fervor. Not long after his departure, the village of Lusigantook was attacked and destroyed by Mohawks[2] who carried away all the young girls as prisoners and among them the hunter's promised bride. When the victors reached their own territory, they tried in vain to persuade our heroine to marry one of their braves, even threatening to burn her alive when she obstinately persisted in her refusal. Many of her tribeswomen had yielded to the inevitable and married Mohawk warriors, but she preferred the stake to breaking her vow. The Mohawk chief, however, would not listen to the cruel counsel[1] of his men and gave the girl a longer time in which to make up her mind, intending, as she was of so brave a nature, to marry her to one of his best warriors, in order that their children might become a race of heroes. When the wandering lover returned and found his home in ashes and his bride carried away, after singing his vengeance song,[2] he gathered together a mighty host of *Wabanaki* and started northward to the Mohawk country, bent on avenging his tribe's defeat and his own loss. After successfully surprising the chief Mohawk village and slaughtering many of the offending tribe, he found and rescued his loved one, who showed her gentle nature by interceding for the Mohawk prisoners whom her lover wished to burn and torture.

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[1] *Lusigantook* is the Passamaquoddy form of the *Abenaki Alsigôntegw*, the name of the St. Francis River in the P. Que., Canada, where the *Abenakis*, akin to the Penobscots, now reside (see PRINCE, '98). The name probably means "river where no habitations are." The indians of St. Francis call themselves *Alsigôntegwiak*.

[2] Canadian Iroquois, see PRINCE '98, p. 376, note 5.

BARTER BY CLOWNS (*nolmihigon*) GAMES. On long winter evenings when the Passamaquoddies wished to pass away the time, they frequently used to amuse themselves by engaging in a game of barter which was carried on by clowns in the following manner: Two parties assembled in separate wigwams where each dressed one of their number in an absurd manner as a *nolmihigon* or clown. This person, carrying some article of more or less value, such as a pair of snow-shoes, a garment, etc., proceeded with the entire company to the wigwam where the second party was waiting, and with many absurd gestures and contortions, offered to exchange the article in question for something else, inviting bids like a modern auctioneer. The point of the joke lay in the witty songs sung by the *nolmihigon* in praise of his wares which nearly always induced the listening company in the second wigwam to pay for the article offered with another of much greater value. Thus, a canoe was not uncommonly exchanged for a wooden spoon! As soon as one exchange had been effected, the first *nolmihigon* and party retired to the original wigwam, where they received a similar visit from the second company. This simple amusement was often kept up far into the night, the wittier *nolmihigon* and his company, of course, coming out winners at the end of the game.

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[1] For the character of the Iroquois' see PRINCE '98, p. 377, note 10.

[2] *Gewajintowagon.*

Ball (*Twiss*). The *Wabanaki* were also very fond of games of ball, one of which called *twiss* was played a great deal by women. They made a large ball of finely picked hemlock twigs which were bound together in the shape of a cocoanut. To this they fastened a light deer-thong some six feet in length, at the end of which was tied a short sharp-pointed stick. The object of the game was to swing the ball or *twiss* and strike it on the rebound with the stick.

Lacrosse (*elni-epesskeuhdin*). A much more active game was that called *elni-epesskeuhdin* which greatly resembled the present lacrosse in principle, practically the only difference being that the Passamaquoddy game could be played by any number of people, so long as both sides had the same number of players. The game was begun by two men standing face to face and endeavoring to drive the ball in opposite directions by means of bats. As soon as the first cast was made, the game became general and each party tried to drive the ball to a goal which their opponents defended. The number of goals necessary to make a game was optional. When the ball-game was over the losing party always had a chance to recover their prestige by choosing one of their number to engage in a foot or canoe-race with a member of the winning side. This form of sport was the inter-tribal game generally played among the *Wabanaki* when one tribe visited another.

Pull-hair ball (*Toohon*). Another very popular ball-game was *toohon* or pull-hair ball, which the Passamaquoddies enjoyed perhaps more than any other sport. Two sides were formed, equal in number, as in *elni-epesskeuhdin*. The ball was then thrown in the air, amid cries of "*toohe! toohe! toohe!*" The man who caught it endeavored to run with it to his side's goal, but unless he was very agile, was pursued by his opponents who tried to pull his long hair in order to make him drop the ball. The players of his own side, of course, defended him as much as possible. When the ball fell, it was immediately caught up again and the sport was resumed.

WITCHCRAFT

The Passamaquoddies, like all North American Indians, are firm believers in witchcraft. A class of wizards and witches (*medolin*)[1] existed among them who were thought to have acquired miraculous powers by means of a special ascetic training. MITCHELL relates in his manuscript Passamaquoddy papers in apparently perfectly good faith that it was no uncommon feat for *medolin* to sink up to their knees in hard ground in the presence of a number of people. He states that the magician always took seven long steps, at each of which he sank up to his knees in the hardest earth. This feat, called *quetkeosag*, is mentioned by Leland in his "Algonquin Legends" (LELAND, p. 341). MITCHELL states also that the *medolin* had the power to change themselves into any sort of animal, adding "This is no superstition, but is a fact witnessed by many members of the tribe." The following witch-song in six sense-stanzas is an illustration of their belief in the power of magic over nature.

Passamaquoddy Witch Song, "The Song of the Drum"

Nil nolbin naga n' tetlitemen pekholagon. Nitutle-wiquotahan weyisesek . . . pehutenek naga ona pechioo wuchowsenel w' chiksitmagon n' pekholagon.	I sit down and beat the drum,[2] and, by the sound of the drum, I call the animals from the mountains. Even the great storms hearken to the sound of my drum.
Nolbin naga n' tetlitemen pekholagon. Pechioo mechkiskak petagik n' tasitemagok pekhola(gon) naga na k' chi applassemwesitt chenisoo w' chiksitmun n' pekholagon.	I sit down and beat the drum, and the storm and thunder answer the sound of my drum. The great whirlwind ceases its raging to listen to the sound of my drum.
Nolbin naga n' begholin. Nitte Chebelaque w' pechiyan naga w' chiksitmagon n' pekholagon. Eltaguak pechite k' chi Wuchowsen	I sit down and beat the drum, and the spirit-of-the-night-air[3] comes and listens to the sound of my drum. Even the great

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[1] Cf. Ojibwe *mĕdēwin* "witchcraft."

[2] Magical drums were generally inscribed with mysterious figures and pictures.

[3] The *Chebelaque* was conceived of as a supernatural monster consisting solely of head and legs, without a body. It was always seen sitting in the crotch of a tree.

w' chenekla oneskee naga w' chicksitmun eltaguak n' pekholagon.	*Wuchowsin*[1] will cease moving his wings to hearken to the sound of my drum.
Nolbin naga n' tegtemen n' pekholagon. Pechioo te Lumpeguinwok moskapaswok naga w' chiksitmunia n' pekholagon naga na Atwusknigess chenaque tehiye naga w' chiksitmun n' pekholagon.	I sit down and beat the drum, and the spirit-under-the-water[2] comes to the surface and listens to the sound of my drum, and the wood-spirit[3] will cease chopping and hearken to the sound of my drum.
Nolbin naga n' tegtemen n' pekholagon naga k' chi Appodumken o' moskatintena negem w' chiksitmun n' pekholagon.	I sit down and beat the drum, and the great *Appodumken*[4] will come out of the deep and hearken to the sound of my drum.
Pesaquetwok, petagiyik, wuchowsenel, machkiskakil, Atwussknigess, applassemwesitt, Lumpeguinwok, Chebelaque; mesioo mame petaposwok nachichiksitmunia eltaguak n' pekholagon.	The lightning, thunder, storms, gales, forest-spirit, whirlwind, water-spirit and spirit-of-the-night-air are gathered together and are listening to the sound of my drum.

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[1] *Wuchowsin* was the storm-bird which sits in the north and makes the gales by the movement of its wings.

[2] *Lŭmpeguin* was the ordinary water-spirit.

[3] *Atwusknigess* was an invisible being who roams the forest armed with a stone hatchet with which he occasionally fells trees with a single blow. The Indians accounted in this way for the sudden fall of an apparently strong tree.

[4] The *Appodumken*, like the *Lŭmpeguin*, dwelt under the water. He had long red hair and was the favorite bugaboo used by Indian mothers to frighten the children away from the water.

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A RECONNOISSANCE OF THE ELIZABETH ISLANDS

ARTHUR HOLLICK

(Read May 15, 1899)

[Plates VIII–XV]

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INTRODUCTION

Location and Names

The Elizabeth Islands, as understood by that name at the present day, comprise the group which extends in a southwesterly direction, for a distance of about sixteen miles, from Wood's Hole, Mass., forming the barrier between Buzzard's Bay on the north and Vineyard Sound on the south; although formerly Martha's Vineyard and its adjoining islands of Chappaquidick and No-Man's Land, seem to have been included under the same name. The principal islands of the group are five in number, besides which there are numerous smaller islands, some of them but little more than isolated heaps of bowlders. Beginning at the eastern end the five are known, in sequence, as Naushon, including Nonamessett, Uncatina, Pine Island, Buck Island

and the Weepeckets ; Pasque ; Nashaweena ; Penikese, including Gull Island ; and Cuttyhunk. Together they constitute the Town of Gosnold and are included with Martha's Vineyard in the County of Dukes, State of Massachusetts.

The names by which the islands are known are of indian origin, but nearly all have undergone more or less change or modification since the time of the aboriginal designations. In an old history of the region[1] may be found the following information relating to them :

Modern Names	Indian Names
Elizabeth Islands.	Nashanow Islands.
Naushon, Naushuan.	Katomuck.
Nonamessett, Monomessett.	Nanomeesett.
Uncatina, Onkatonka.	Uncatincett.
Pasque, Pesque.	Peshchameesett, Pesquineese.
Nashaweena.	
Penikese, Peniquese.	
Cuttyhunk.	Poocutohunkunnoh.

The latter also appears to have been known as the original Elizabeth Island, before the name was made to include the entire group.

It may perhaps also be of interest to note that the name Buzzard's Bay is said to have been derived from "Buzzardet" or little buzzard, the name under which the fish hawk was formerly known and which were very abundant there.

The name Weepecket is supposed to be a corruption of "Wabacuck," the Indian name for the bald eagle.

General Information

The islands had attracted my attention and had aroused my curiosity and interest for some time, partly because little or nothing had been written in regard to them[2] and partly for the reason that definite information in relation to them was necessary as a logical sequence to my previous investigations in the vicinity, on Long Island, Block Island, Martha's Vineyard and Nantucket. This entire region was recognized as having been involved in one series of cause and effect, especially during the Quaternary and modern periods, so that any new facts in regard to any portion of the region would be of importance in arriving at final conclusions in regard to the whole.

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[1] The History of New Bedford, Bristol County, Massachusetts, etc. Daniel Ricketson. New Bedford, 1858.

[2] The earliest reference which I have been able to discover is entitled "Notices on the Geology of Martha's Vineyard and the Elizabeth Islands," by EDWARD HITCHCOCK, in *Am. Journ. Sci.*, vii. (1824), 240–248, but the geological features were merely noted by him in passing by the islands and they are exceedingly brief and superficial.

When I came to look into the matter, however, I found that the proposed trip was not without certain difficulties. Each island is owned by some one individual, family or corporation, with the exception of Cuttyhunk, upon which there are a number of separate holdings, hence there is no line of public travel to or through the group, no public conveyances and no houses of public entertainment, except in connection with Cuttyhunk, and consequently any stranger desiring to explore the group must be dependent upon the good will and courtesy of the owners for both transportation and subsistence.

As soon as my object became known, however, every possible facility was placed at my disposal, and in this connection I wish to acknowledge my indebtedness to Mr. J. Malcolm Forbes; to Mr. J. Crosby Brown and other members of the Pasque Island Club; to Mr. Edward B. Merrill; to Mr. Geo. S. Homer; and to Mr. Wm. A. Woodhull and other members of the Cuttyhunk Club, for facilities and courtesies extended to me respectively on Naushon, Pasque, Nashaweena, Penikese and Cuttyhunk, without which facilities and courtesies the trip as finally accomplished would have been impossible.

Itinerary of the Trip

The trip occupied exactly a week, from August 10, 1898, to August 16th, inclusive. It was begun at the eastern end, at Wood's Hole, from whence the Forbes' steam launch was the means of transportation from the mainland to Naushon, where accommodation was provided for me at the farm house.

August 11th was spent on foot, exploring Nonamessett and Uncatina.

August 12th a horse and wagon was placed at my disposal, by which means I was enabled to drive through Naushon, from end to end, under the guidance of Mr. Frederick H. Lambert, the overseer, and to reach Pasque by rowboat on the same day, where the Pasque Island Club extended its privileges to me.

August 13th was devoted to an exploration of Pasque on foot, after which a sailboat was provided on which I was transported to Nashaweena, where I was received as the guest of Captain John E. Johnson, the representative of the owner.

August 14th was spent on horseback, under the guidance of Captain Johnson, traversing the shore line of Nashawena, with occasional diversions inland.

August 15th was occupied in sailing to Penikese, where about three hours were given to an examination of the island on foot, and thence, again by sailboat, to Cuttyhunk, where I was the guest of the Cuttyhunk Club.

The remainder of the 15th and part of the 16th of August were utilized in field work on Cuttyhunk, after which the regular steamboat was taken to New Bedford.

DESCRIPTION OF THE ISLANDS

[Map, Plate XV.]

Naushon

This island, owned by the Forbes family, is the largest of the group, having a length of about eight miles and averaging about one and one-half mile in width. Uncatina and Nonamessett are joined with it by means of causeways. It is the only one from which the trees have not been removed, and, fortunately, those who have been in possession since the early days—the Winthrops, Swaynes, Bowdoins and Forbes—have keenly appreciated the beauty of natural surroundings and in consequence the larger part of the island is yet covered by a forest growth of primeval wildness, which is jealously preserved from either the destructive attacks of the utilitarian or the conventionalizing of the landscape architect. Even the few roads, which of necessity have been laid out, are to a great extent but little more than well-cleared wagon tracks, which follow the natural winding contours of the surface, or occasionally curve or twist in an unexpected manner, in order to avoid the destruction of, or to bring into view, some striking feature, such as a large tree or bowlder.

The forest growth was a revelation, as most of it had all the appearance of never having been disturbed by civilization. The trees are in every stage of growth, from seedlings and small saplings to those which are in their prime or past it, while lying on the ground, where they have fallen naturally, are the decaying trunks of former generations.

Taken as a whole the arborescent flora is similar to that of the mainland adjacent, and there is as much difference between it and that of Martha's Vineyard, only about four miles distant, as there is between the flora of the New Jersey highlands and that of the pine barrens. There are a few scattered individuals of *Pinus rigida* Mill., and *P. sylvestris* L. has been introduced and planted to a considerable extent, but aside from these two species the trees are almost wholly deciduous, consisting largely of *Fagus Americana* Sweet., *Quercus alba* L., *Q. rubra* L., *Q. velutina* Lam., and a plentiful sprinkling of *Ostrya Virginiana* (Mill.) Willd. There are a few good sized individuals of *Ilex opaca* Ait., widely separated, and *Cytissus scoparius* (L.) Link. has been planted over quite extensive areas, formerly denuded, in order to secure a quick growth of vegetation. This did not appear to be in a very thriving condition however, and in places large patches had apparently died out completely. The arborescent feature, however, which is sure to attract immediate attention is the great abundance of beeches. In certain sections there are acres of the forest where this tree monopolizes fully nine-tenths of the growth, and a complete tree census of the island would undoubtedly show it to be in a considerable majority.

On the outskirts of the forest, or where isolated individuals or clumps of trees occur, a remarkable effect of the winds may be seen. The branches on the side exposed to the unbroken winds are short and stunted, while to the leeward they are elongated and stretch out often to extraordinary lengths. The trees present the appearance of having been artifically trimmed on the windward side so that only half the tree remains. This feature is particularly conspicuous on windward slopes, where the long leeward branches of large trees often extend out and droop until they rest upon or nearly touch the ground thirty or forty feet distant from the trunk, while where the trees grow in hollows or depressions the force of the winds checks the upward growth as soon as it reaches the level of the surrounding hills, leaving a remarkably uniform surface over the entire mass of the tree tops.

Another peculiar effect is also produced by these conditions in the relative heights of trees. The trunks of those which grow in the bottom of any depression are tall, while those on the sides are successively shorter and shorter, according as their location approaches the summit, although the diameters of the trunks may vary but little. Many individuals may thus be singled out in which the lateral extent of the branches is out of all proportion to the height or diameter of the trunk, giving a most weird and peculiar appearance to the tree. These phenomena due to wind action are particularly conspicuous on the south side of the island, which is exposed to the full force of the ocean storms. [**Plate VIII.**]

The denuded areas present but few botanical features which differ from those of similar morainal areas on the adjoining mainland. They are wind-swept and almost destitute of any conspicuous vegetation except for patches of *Myrica cerifera* L., and stunted growths of *Vaccinium* and *Gaylussacia*. *Euthamia Caroliniana* (L.) Greene seemed to be about the most abundant or conspicuous herbaceous plant in such situations, at the time of my visit.

A species perhaps wortny of special mention is a form of *Plantago major* L., found on Uncatina. It was in considerable abundance, although apparently restricted in its habitat to a zone located just above high-water mark. My attention was at once attracted to it by reason of its lanceolate 3-nerved leaves and the fact that the entire plant was more or less covered by a short hoary pubescence. More extended examination may prove it to be worthy of varietal rank.

The island is composed of a series of rounded morainal hills, with a maximum elevation of 160 feet. Many of the depressions are amphitheater-like in form, in some of which there are swamps or ponds, often without visible outlets. One of these is occupied by West End Lake, a body of clear fresh water, some 45 acres in area, the surface of which is usually about 5 feet above tide level, while the bottom is said to be about 75 feet below. At the time of my visit a considerable stream was flowing from it, although this was stated to be not always the case and due to the unusually wet season and recent heavy rains. In its general features it is strikingly like Lake Ronkonkoma on Long Island and is evidently caused by similar morainal conditions. Its limited drainage area would, alone, be insufficient to account for the almost uniform level maintained by the water, but the depth of the basin, and its nearness to tide water at once suggests that seepage may account for it, augmented at time of rains by surface drainage, when it overflows. If the depth quoted is correct, the bottom is lower than that of any portion of Buzzard's Bay adjacent.

In several localities, notably in the vicinity of Tarpaulin Cove, the accumulation of bowlders is especially conspicuous, both for numbers and size, and they may be seen to advantage either where they are completely exposed on the shore [**Plate IX**] or partially so in the adjacent hills, interspersed with patches of stunted *Myrica cerifera* L. [**Plates X, XI**]. "Fern Rock" is an immense bowlder, partly fractured and covered by a luxuriant growth of *Polypodium vulgare* L., situated in a dense wood not far from West End Lake.

The general topography of the island is characteristically morainal and the larger part of the bowlders are granitic. Around the more sheltered north shore and in the coves and inlets, away from violent wave action, the beach shingle largely retains its original angular character as glacial drift material and there is but little observable difference between it and material freshly washed out from the adjoining sloping banks, from the base of which there is a uniform grade to the water's edge. On the exposed southern shore however the shingle is rounded and water-worn and in places is thrown up into extensive ridges, beyond ordinary high-water mark, by wave action during storms, often masking the base of the adjacent bluffs and causing an abrupt line of demarkation between the irregularly wave-tumbled, rounded beach shingle, and the steep face of the eroded moraine, with its angular ice-transported fragments. It is along this shore that erosion is proceeding most extensively, as may be readily seen in the steep escarpments of the bluffs which face it, and also in the rapid descent to deep water, as evidenced by the location of the submarine contours.

Inasmuch as these islands, considered as a whole, seemed to bear every indication of being simply a partly submerged and gradually disintegrating ridge in the morainal region south of the New England shore line, it was recognized that theoretically they ought to have the same general structure as the similar but larger ridge to the south, represented by Long Island, Block Island, Martha's Vineyard and Nantucket. In other words that the superficial morainal material ought to be found resting upon a superstructure of Cretaceous strata. A careful search was therefore made for plastic clays and also for the ferruginous clay concretions and hardened fragments, which are invariably found under similar conditions in the islands mentioned. Such concretions were finally found on Nonamessett, and by tracing them up a bed of plastic clay, some of it highly lignitic, other portions brightly colored in reds and yellows, was found at the base of a bluff on the south shore, near the eastern end. No organic remains, other than the lignite were found, but the lithologic identity of the concretions and plastic clays with those of Gay Head, Block Island and Glen Cove was unmistakable. At no other locality was any indication of either the clays or the concretions discovered, although this is hardly to be wondered at considering the limited time given to the exploration.[1]

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[1] The only reference which I have seen in regard to the occurrence of Cretaceous clays in the Elizabeth Islands is in a paper on "Glacial Brick Clays of Rhode Island and Southeastern Massachusetts," by N. S. Shaler, J. B. Woodworth and C. F.

Considered from the social standpoint the island constitutes a magnificent domain, easy of access and yet unspoiled by the destructive elements of civilization. It is a place in which deer and other wild creatures roam and breed freely amid natural surroundings and the general impression is that of a home of modern luxury and culture located in a wilderness, such as one would never expect to find in this part of the United States.[1]

Pasque

This island, owned by the Pasque Island Club, an organization devoted to striped bass fishing, has an area of about 1 ½ square miles and is entirely treeless, except for a small clump of *Pinus sylvestris* L., which was planted near the club house, at the eastern end. It is a dome-shaped portion of the moraine, somewhat elongated in an east and west direction, with a maximum elevation of about 120 feet through the central axis and sloping irregularly in all directions to the shore line. In consequence there are no very high bluffs anywhere exposed and no sections of any extent are available for study.

Swamps occupy many of the depressions, in which *Clethra alnifolia* L. and *Decodon verticillatus* (L.) Ell. are conspicuous and *Oxycoccus macrocarpus* (Ait.) Pers. is plentiful. The hills are bare and wind-swept, resulting in a sort of turf composed of stunted herbaceous plants of several species, as well as grass, of which *Solidago nemoralis* Ait. and *Aster ericoides* L. are the most prominent constituents. *Chrysopsis falcata* (Pursh) Ell., *Sericocarpus linifolius* (L.) B. S. P., *Hieracium Canadense* Michx., *H. Gronovii* L. and *Gyrostachys gracilis* (Bigel) Kuntze, were also in sufficient abundance to be specially noticed.

The general superficial geological conditions are identical with

Marbut, in the 17th Annual Report of the United States Geological Survey, Part I., pp. 951–1004, where they are incidentally mentioned on pp. 962 and 983, without, however, giving any exact locality. On the latter page is also figured a theoretical section through Buzzards' Bay, Naushon, Vineyard Sound and Martha's Vineyard.

[1] Those who are interested in this phase of the subject may find a reference to the social life of the island in Oliver Wendell Holmes' "Autocrat of the Breakfast Table," Chapter II., and an illustrated popular account by Gustav Kobbé in the *Century Magazine*, LVI (Sept., 1898), 753–759.

those of Naushon, but the entire absence of arborescent vegetation has caused the effects of rain and wind erosion to be more pronounced. Wherever the turf is destroyed erosion is rapid and depressions are soon formed by the removal of the finer material, leaving the bowlders prominently exposed.

Around the shores the effects of wave and wind action are very pronounced. In places where depressions have been reached by tide water, in the gradual recession of the shore line, these are often dammed by an accumulation of wave-thrown shingle and the result is the formation of a swamp or pond. [**Plate XII.**] The dam is constantly pushing further and further inland and every stage in the evolution and final obliteration of such a swamp or pond may be seen. Often the old swamp deposit, with the water seeping through, may be found exposed on the slope of the beach at low tide—the sole reminder of these former conditions. Occasionally dune sand accumulates on the dams and vegetation obtains a foothold, in which case a compact barrier beach results.

Bolted firmly to the bowlders on the shore and in the adjacent water, and extending out for a considerable distance, are the fishing stands, each one provided with a seat, on which the fisherman may sit, and any description of the island would be incomplete without at least a brief reference to this feature. [**Plate XIII.**]

Nashaweena

This island, owned by Mr. Edward B. Merrill, is next in size to Naushon, having a length from east to west of about three miles and an average width of about one mile. The greatest elevations are about 125 feet, in a series of scattered hilltops, located towards the southwestern part of the island. Good sections of about 60 or 70 feet are exposed in the bluffs on the south shore near the west end, which show stratified, grayish, sandy clays, similar to those which are prominent in Mohegan Bluffs on Block Island and at Montauk Point on Long Island, and on which the superficial bowlder till rests—the entire series representing the varying conditions which obtained during the Quaternary period. The probable age and conditions of deposition of these strata are well discussed in the report on "Glacial Brick Clays, etc.," previously quoted.

Although there is constant general erosion and recession of the coast line on all sides, there are places where land has evidently been making in recent times. This is noticeably the case at the east end of this island, where the former shore may be traced around the borders of the low swamp land in that vicinity, by means of the old beach shingle, now almost entirely hidden by extensive dune deposits. This was apparently a cove or embayment, before Quick's Hole had been broken through, and doubtless the formation of that channel so altered the previous conditions that new tidal currents were established and deposition began in places where erosion had previously prevailed. Quick's Hole, as well as each of the other channels between the islands, apparently began as coves on opposite sides of the land, the shore lines of which gradually progressed inward, by reason of subsidence and erosion, until they finally met, when, a break once made, tidal scouring soon caused the formation of a channel. The relative locations of and conditions in connection with Tarpaulin and Kettle Coves, on Naushon, indicate such a series of present and future effects.

Nashaweena supports some quite extensive clumps of stunted trees, which are mostly massed in the depressions and on the sheltered slopes of the northeastern portion. The sheltered areas are more numerous and larger than on Pasque and vegetation in general is more abundant. It does not differ materially from that of Naushon, except for the greater relative abundance of oaks as compared with beeches. One or two holly trees were noticed, but I was unable to ascertain whether or not they were native. Probably the most conspicuous botanical feature was the masses of *Clethra* in the swamps. Water lilies were very abundant in the shallow ponds and mushrooms were to be found in nearly all the pastures. The only plant collected, however, to which particular attention need be called, was a single specimen of *Centaurea arenaria* Bieb., an introduced species, which I believe has not heretofore been reported from the United States.

Except for one farm house there is no human habitation on the island, which is a complete wilderness, utilized only as a sheep range, but serving occasionally as a refuge for some of the deer from Naushon, which at times swim over from there.

Penikese

This little island, now owned by Mr. Geo. S. Homer, is about ¼ square mile in area, and is probably most widely known as having been, during one period of its history, the home of Agassiz's school. It rises from the shore line on all sides to a height of some 85 feet near the center, and is about as barren and unattractive a pile of gravel and bowlders as can well be imagined. The only plant sufficiently conspicuous to attract my attention, was *Solanum rostratum* Dunal, which was growing in abundance around the ruins of the old school.

Certain species of terns breed there in immense numbers, and while wandering over the nesting grounds I saw perhaps a score or more of this season's young ones hopping and fluttering over the grass and stones, evidently unable to fly. Several were picked up in order to examine them, and in each instance it was found that one or both wings were aborted. The number of these cripples was evidently considerable, as I saw the dead bodies of many others. All, of course, must have died of starvation as soon as they were finally deserted by the old ones. At the time of my visit the entire colony was yet there and the frightened cries of the cripples at once attracted all the birds in the vicinity, who formed a vast whirling cloud, hovering close overhead, individuals from the mass every now and then making closer downward swoops and all joining in making a deafening noise. It was a sight alone worth a journey to the island to see.

Cuttyhunk

This island is the only one of the group which is divided amongst a number of owners. It has an area of about 1½ square miles and a maximum elevation, near the center of the eastern end, of about 150 feet. This elevation forms a bold headland, which slopes abruptly to the adjacent shores, while at its western end it merges into the central ridge which gradually becomes lower and lower until it reaches tide level. As these hills are absolutely destitute of trees, the sky line from almost any direction is peculiarly sharp and conspicuous. [**Plate XIV, Fig. I.**]

A sand spit of recent deposition is a prominent feature at the eastern end, which extends almost to Nashaweena, from which it is separated by Canapitsett Gut. As in the case of the similar deposit mentioned at the eastern end of Nashaweena, it is probably due to the eddies and currents which were established subsequent to the formation of the passage between the islands. Facing the southern and western shores there are precipitous bluffs, in which good sections are exposed. The material is entirely of glacial origin, but bowlders are fewer than on the islands to the eastward. The finer deposits are of grayish sandy clay, for the most part distinctly stratified.

Except for the few trees planted in the vicinity of the little settlement at the eastern end, the island is absolutely treeless, although there is abundant evidence that at one time it was well wooded. Near the western end, on the south shore, is a depression once occupied by a swamp, one edge of which is exposed by the breaking away of the bluff. In the bottom of this depression may be seen numerous large stumps and logs, buried in a peat-like mass of fine vegetable debris, and subsequent microscopic examination of specimens collected showed these to be oak and beech.

In the "History of New Bedford, etc.," previously mentioned, there are numerous references to Bartholomew Gosnold's account of the island, which he called "Elizabeth Island." In Gabriel Archer's journal of Gosnold's voyage he says: "On the north side, near adjoining unto the island of Elizabeth, is an islet in compass half a mile, full of cedars, by me called Hill's Hap." [Penikese.] He also notes that Elizabeth Island [Cuttyhunk] was covered with trees—"oaks, ashes, beeches, walnut, witch-hazel, sassafras, and cedars, with divers other unknown names."

In the account of the voyage written by John Brereton he also describes Cuttyhunk as thickly wooded, principally with beech and cedar. They also found, he says: "red and white strawberries, as sweet and much bigger than ours in England," also raspberries, gooseberries and whortleberries. He next mentions the "great store of deer and other beasts, as appeared from their tracks" and finally states that they all grew fat on the young sea fowl which they found in nests upon the banks and in low trees.

CONCLUSIONS

If the superficial facts, as previously outlined, be considered in connection with the adjacent submarine contours,[1] it may be readily seen that a comparatively slight elevation would completely drain the channels which now separate the islands from each other and from the mainland and would convert the entire series into a long peninsula, consisting of a range of morainal hills extending in a southwestern direction from Wood's Hole.

In order to emphasize this point I have prepared the accompanying map [**Plate XV**] of the islands, showing the location of the 8-fathom contour,[2] together with the few other soundings of greater depth in Buzzard's Bay and Vineyard Sound. From this it may be seen that if the 8-fathom contour be considered as the shore line of a previous period in the history of the region, not only would the islands form a continuous ridge of land, but this ridge would be considerably extended both in length and width and Buzzard's Bay would be almost obliterated.

If the windings of the contour be followed around it is evident that the indication of the first break which was made through the ridge is at Quick's Hole and that the area which includes Nashaweena, Cuttyhunk and Penikese formed one island before Pasque and Naushon had been separated from each other or from the mainland. Penikese was apparently the next to be isolated, then Cuttyhunk and Nashaweena, then Pasque and finally Naushon.

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[1] See Coast Survey Chart No. 112. Vineyard Sound and Buzzard's Bay.

[2] NOTE.—My reason for taking the 8-fathom contour was because a contour of any greater depth would almost entirely eliminate Buzzard's Bay as a former feature of the region.

From the location of the islands and the general character and arrangement of the material of which they are composed, it is evident that they represent a partially submerged morainal ridge, probably a portion of the later, northern branch of the terminal moraine, represented by Orient Point on Long Island, Plum Island, Gull Islands and Fisher's Island. That these represent a more recent stage of glacial action than Montauk Point, Block Island and Martha's Vineyard is also strongly indicated by the almost total absence of Cretaceous material, which is so characteristic of the earlier or southern branch of the moraine. Nearly all of this material, on account of its incoherent character, would almost inevitably have been eroded on the first advance of the ice sheet over the Buzzard's Bay and Vineyard Sound area, and subsequently incorporated in the first moraine, as we find to be the case on Martha's Vineyard. A precisely similar case is also presented by the eastern end of Long Island, where the older branch of the moraine, represented by Montauk Point, contains practically all of the eroded cretaceous material, while the more recent branch, represented by Orient Point, contains almost none.[1]

Under the circumstances we may consider it as peculiarly fortuitous that the limited exposure of plastic clay on Nonamessett has been preserved, while the close proximity of this to the mainland indicates that there may yet remain some isolated patches which have resisted or escaped erosion, farther up the old estuaries, where theoretically the formation once extended.

Whether the ridge represented by the Elizabeth Islands was caused by an inequality in the crystalline rocks beneath we are hardly in a position to say, but reasoning from analogy the probabilities are against this idea and the inferential relations between these rocks, the Cretaceous clays and the Drift deposits, according to the facts now in our possession, I have endeavored to indicate in the accompanying section from New Bedford to Martha's Vineyard. [**Plate XIV, Fig. 2.**]

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[1] For more extended discussion of this phase of the subject see: *Trans. N. Y. Acad. Sci.*, XII (1893), 189–202; 222–237; XIII (1893), 8–22; (1894), 122–132; XV (1895), 3–10; XVI (1896), 9–18 and *Ann. N. Y. Acad. Sci.*, XI (1898), 55–88.

PLATE VIII.

PLATE VIII.

Sketch, showing bowlders and wind-contorted trees, south side of Naushon. Page 392.

PLATE IX.

PLATE IX.

View of the shore at Tarpaulin Cove, south side of Naushon, showing bowlders. Page 393.

PLATE X.

PLATE X.

View of a portion of the morainal hills, near Tarpaulin Cove, showing bowlders. Page 393.

PLATE XI.

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PLATE XI.

View of a portion of the morainal hills, near Tarpaulin Cove, showing bowlders and patches of stunted *Myrica cerifera* L. Page 393.

PLATE XI.

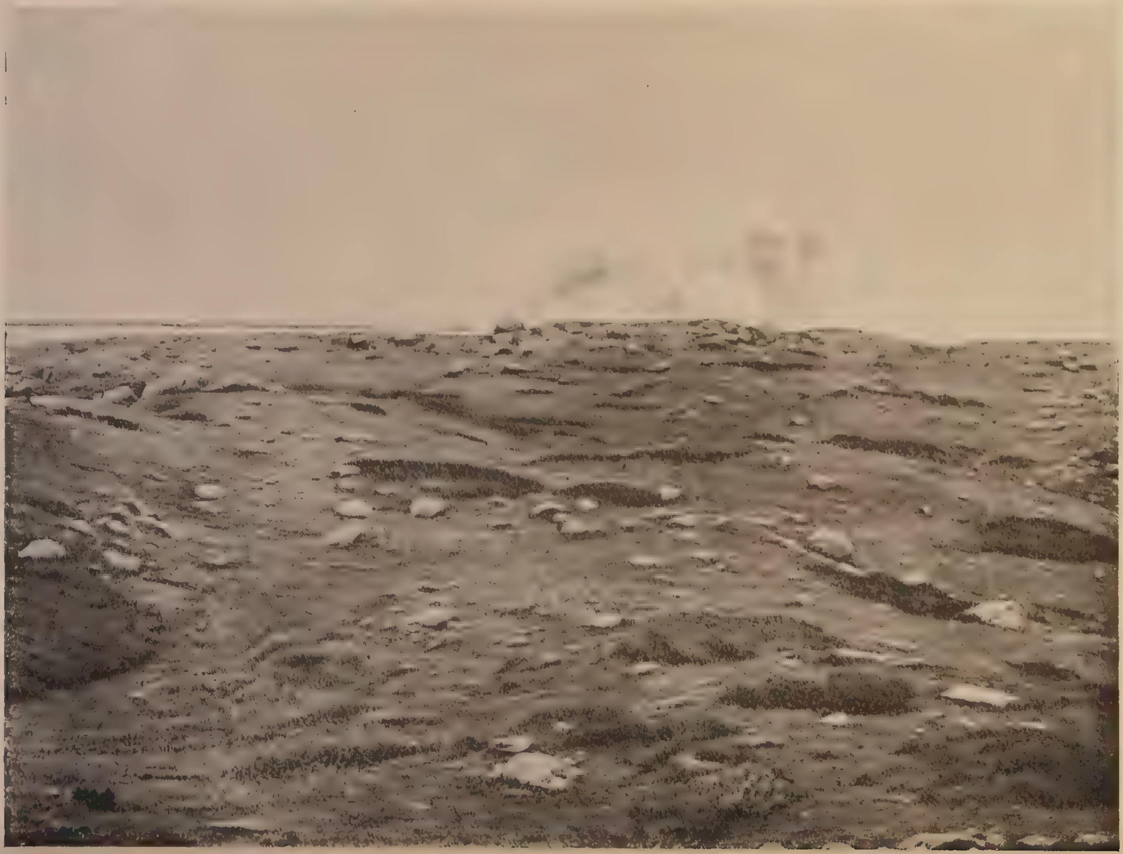


PLATE XII.

PLATE XII.

View of a portion of a depression, occupied by a swamp and dammed by a barrier beach. South shore of Pasque. Page 396.

PLATE XII.

PLATE XIII.

PLATE XIII.

Sketch, showing bowlders and stands for striped bass fishing, south shore of Pasque. Nashaweena in the distance. Page 396.

PLATE XIII.

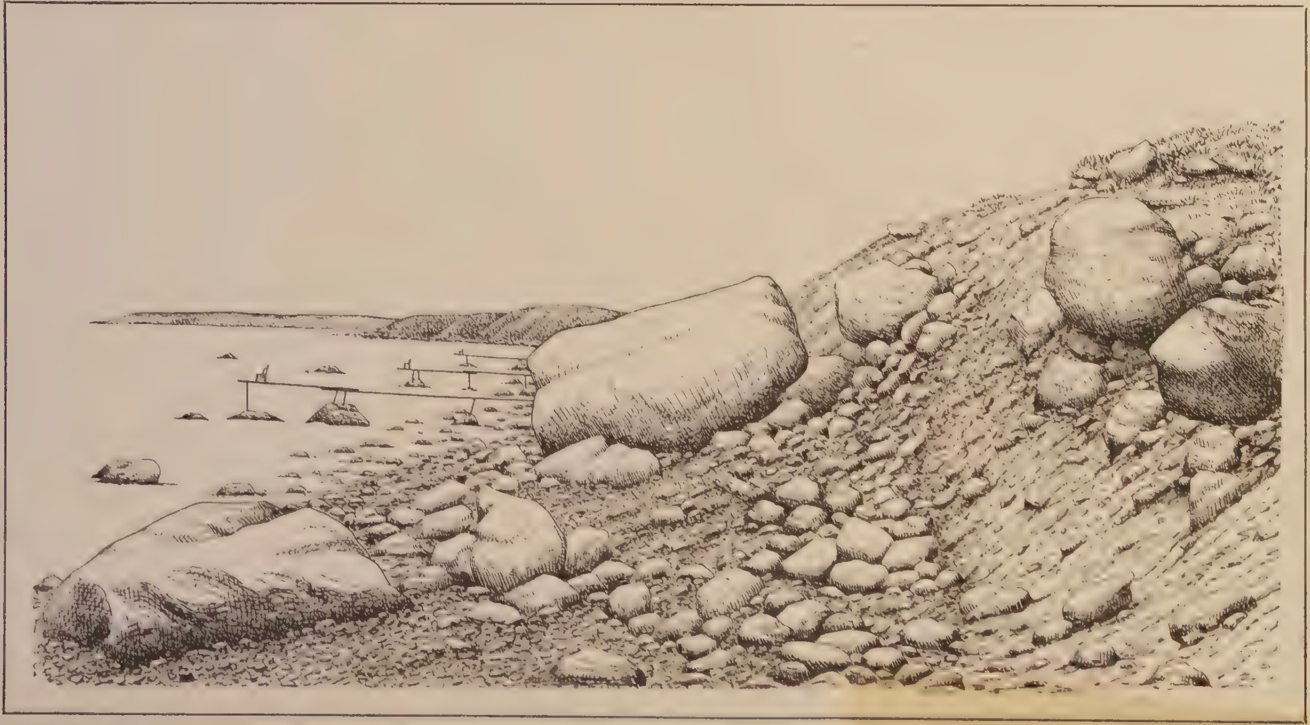


PLATE XIV.

PLATE XIV.

FIG. 1. Sketch, showing the sky line of the central morainal ridge of Cuttyhunk, from northeast to southwest. Page 399.

FIG. 2. Geological section, from New Bedford to Martha's Vineyard, showing the theoretical relations between the Cretaceous clays, the crystalline rocks below and the Quaternary deposits above. Page 401.

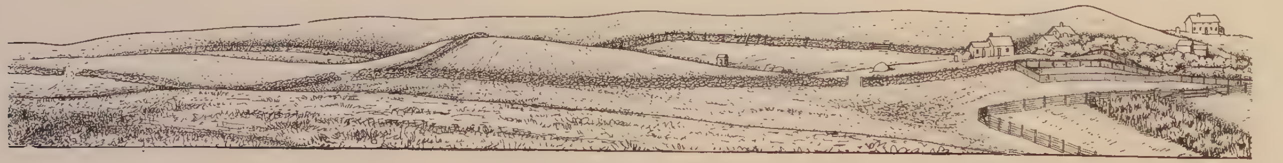


FIG I.

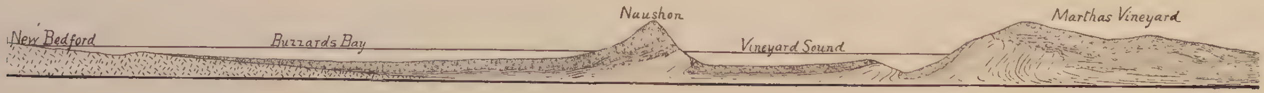

New Bedford
Buzzards Bay
Naushon
Vineyard Sound
Marthas Vineyard

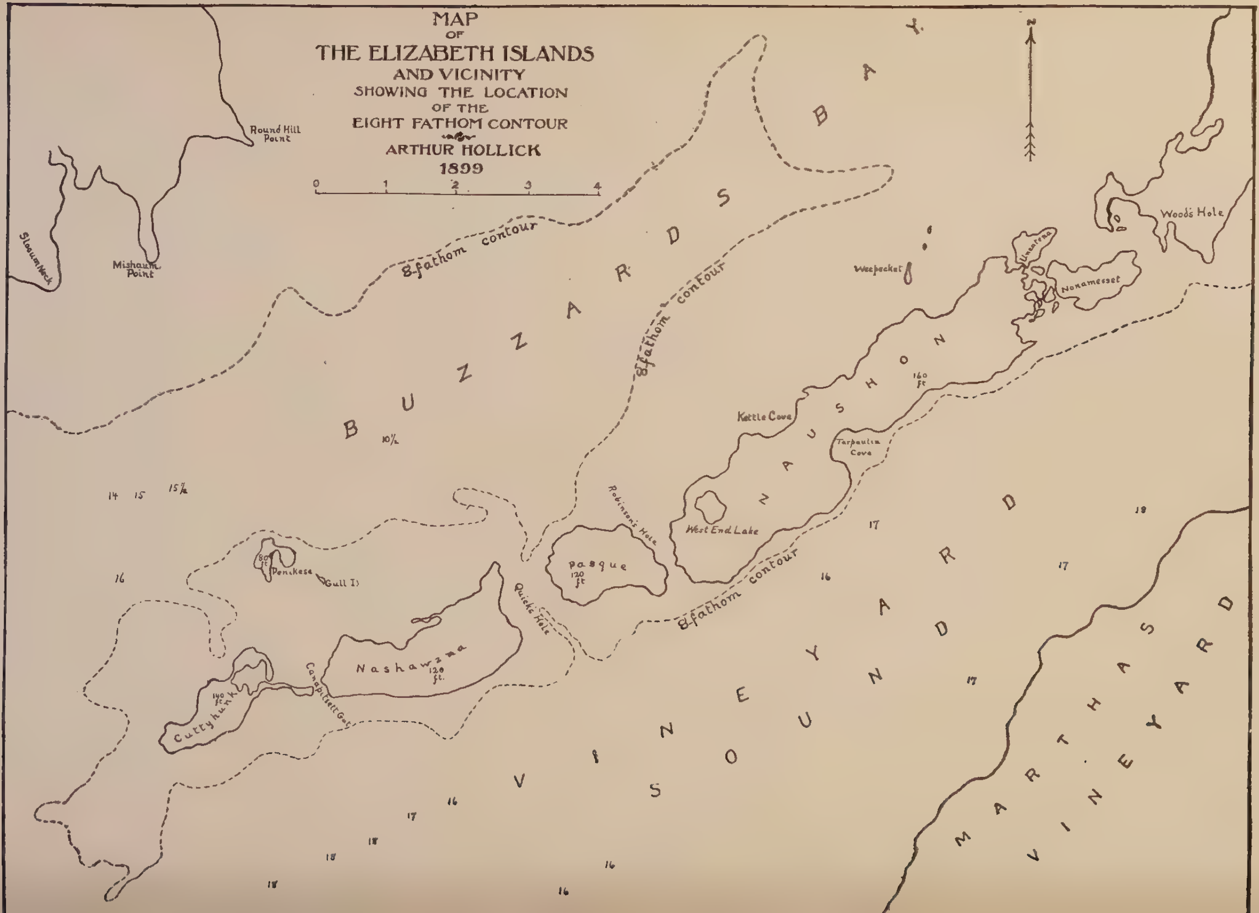
FIG. 2.

PLATE XV.

PLATE XV.

Outline map of the Elizabeth Islands and vicinity, showing the location of the 8-fathom contour. Pages 390 and 400.

PLATE XV.


MAP
OF
THE ELIZABETH ISLANDS
AND VICINITY
SHOWING THE LOCATION
OF THE
EIGHT FATHOM CONTOUR
ARTHUR HOLLICK
1899
0
1
2
3
4
N
BUZZARDS BAY
VINEYARD SOUND
MARTHAS VINEYARD
Round Hill Point
Mishaum Point
Slocum Neck
8 fathom contour
8 fathom contour
8 fathom contour
Weepecket
Uncatena
Nonamesset
Wood's Hole
NAUSHON
160 ft
Kettle Cove
Tarpaulin Cove
West End Lake
Robinson's Hole
Pasque
120 ft
Quicks Hole
Nashawena
120 ft.
Canapitsett Gut
Cuttyhunk
140 ft
80 ft
Penikese
Gull I.
10½
14
15
15½
16
16
17
18
18
18
16
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17
17
18

[ANNALS N. Y. ACAD. SCI., VOL. XIII, No. 6, pp. 419–430, Jan. 14, 1901.]

PRELIMINARY NOTES ON THE OCCURRENCE OF SERPENTINE AND TALC AT EASTON, PENNA.

F. B. PECK

[Plate XVI ; text figures 4, 5]

(Read January 30, 1900)

The band of pre-Cambrian rocks which extends across the northern part of New Jersey in a southwesterly direction, crosses the eastern border of the State of Pennsylvania between Easton on the north and Kintnersville on the south. The band is here broken into a series of parallel ridges consisting chiefly of hornblende gneiss with intervening valleys of dolomites of post-Algonkian age.

The northernmost of these ridges is the southwestern extension of Scott's Mountain in New Jersey and crosses the Delaware river just north of Easton. On the Pennsylvania side of the river it is known as Chestnut Hill. Just across the river on the New Jersey side it is known as Marble Mountain.

Chestnut Hill is a rather sharp, even-crested ridge, having a maximum altitude of 700 feet above tide, and having a general trend of S. 60° W. It diminishes in altitude toward the southwest, and at a distance of four and one-half miles from the Delaware river disappears under the post-Algonkin dolomites. This, with two other similar ridges north and west of Bethlehem, twelve miles distant, constitutes the only recurrence of pre-Cambrian rocks in Pennsylvania north of the Lehigh River. A description of it as regards composition and structure will constitute the substance of this paper.

Chestnut Hill is composed of a dense hornblende gneiss with distinct bedding planes which dip at an angle of from 40° to 60° to the southeast. Interstratified in the gneisses are beds of carbonates of varying thickness (5 feet to 30 feet) consisting usually of a mixture of pink calcite and gray dolomite but occasionally consisting wholly of either the one or the other.

Hornblende (usually tremolite), phlogopite, and occasionally pyroxene occur so abundantly in these beds as locally to replace all or nearly all the carbonates, so that locally they become altered to a nearly pure tremolite rock with streaks or patches of phlogopite or pyroxene or containing at time considerable amounts of the original carbonates. These tremolite beds are confined to the southeastern slope of Chestnut Hill, and at the southwestern extremity of the ridge lie for the most part at or near the contact of the post-Algonkian dolomites on the pre-Cambrian gneisses. Here, as can be seen in the cut made by the Bushkill Creek, all three, viz., the dolomites, the tremolite beds and the pre-Cambrian gneisses dip uniformly to the southeast and are apparently conformable. (See **Fig. 4.**)

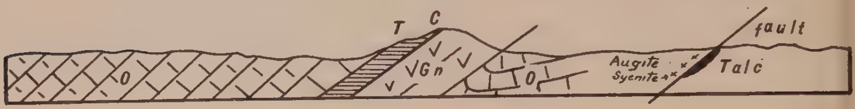

FIG. 4. Section No. I, taken along Bushkill Creek. *O* = Post-Algonkian dolomites; *T* = Tremolite beds presumably altered form of *C* which = calcite-dolomite beds; *Gn* = pre-Cambrian gneiss.

The explanation of the occurrence here of beds of tremolite would seem to be simple. In the first place the post-Algonkian dolomites are more or less silicious as the following analysis shows:

SiO_2 = 3.52
Fe and Al = 2.92
$CaCO_3$ = 53.40
$MgCO_3$ = 40.54 100.38

Immediately below them come the beds of carbonates which are usually highly dolomitic and may have contained original silica. Underlying these in turn are the pre-Cambrian gneisses which with their included quartz lenses and granite intrusions could furnish free quartz enough by infiltration to transform the beds of carbonates over into silicates of lime and magnesia, and it is not impossible that the overlying post-Algonkian dolomites may have played some part in the formation of these tremolite beds. This process of transformation was doubtless greatly facilitated by dynamical forces resulting from faulting, as will appear later.

Into these, what we may term altered pre-Cambrian sediments, viz., the gneisses with their interstratified bed of carbonates, have been intruded in this limited area at least two kinds of eruptives.

The first and by far the most abundant is a coarse hornblende granite, which occurs in the form of lenses and bosses, the principal outcrop of which lies on the southeastern slope of Chestnut Hill just across the Delaware River from the southernmost extremity of Marble Mountain. It varies from a very coarse to a fine grained rock and is for the most part highly feldspathic, consisting almost wholly of orthoclase but containing varying amounts of quartz and an occasional blade of dark green hornblende. In the contact zone the hornblende predominates, replacing locally nearly all the quartz and feldspar.

The other eruptive, an augite syenite, occurs in much smaller quantities but presents some points of interest which had best be enumerated here. It appears as a much altered type in the serpentine-tremolite rocks, to be described later, lying in the northern part of the granite area above described. It appears again in the same manner in a series of dykes cutting across the beds of gneiss at the northern end of the Bushkill cut. Its principal occurrence, however, is at a point one-half mile east of Walter's Station on the Bushkill Creek, where some six distinct outcrops appear along an obscure fault (marked M. N.) which has the same trend as the gneiss ridge south of it. It occurs in the post-Algonkian dolomites and may have been intruded in the form of a dyke along which slipping subsequently took place, or it may have been faulted up from below.

Macroscopically the rock consists of an abundance of dark green augite with very little feldspar which gives the rock a very basic appearance. It is for the most part fine grained but is occasionally quite coarsely granular, almost granitoid in texture and shows about equal amounts of feldspar and augite with a sprinkling of biotite scales.

In microscopic thin section the rock is seen to have as its most prominent constituent hypidiomorphic augite, having the peculiar green tinge of the soda bearing variety. On separation with Toulet's solution it gave the following analysis:

$$\begin{array}{lll} SiO_2 & = 50.55 & \\ \left.\begin{array}{l} FeO \\ Fe_2O_3 \end{array}\right\} & = 7.27 & \\ Al_2O_3 & = 8.66 & \\ MgO & = 11.00 & \\ CaO & = 19.70 & \\ Na_2O & = 1.70 & \\ K_2O & = .48 & \underline{99.36} \end{array}$$

which shows an approach to an ægirine augite.[1]

The allotrimorphic feldspars, as a rule about equal in quantity to the augite, consist usually of microperthitic intergrowths of albite or oligoclase and orthoclase. The feldspars generally show a wavy extinction due to pressure and frequently the confused, patchy intercrystallization seen in many syenites containing nearly equal amounts of both soda and potash. On isolation the feldspars were shown by an alkali determination to contain 8.04% of potash and 4.55% of soda.[2] The last constituent of importance is biotite which in one locality quite replaces the augite and the rock thus becomes essentially a mica syenite. Magnetite occurs in but limited quantities. Long prisms of apatite are quite abundant in places and were as usual among the first crystals to form, being included in both the biotite and augite.

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[1] This separation and analysis was made by Mr. Fred H. Moffit, post-graduate student in geology and assistant in chemistry in Lafayette College, Easton, Pa.

[2] This determination was also made by Mr. Fred H. Moffit.

An analysis of the rock as a whole gave the following:

SiO_2 = 53.58
Al_2O_3 = 13.56
Fe_2O_3 = 1.48
FeO = 4.75
CaO = 8.20
MgO = 8.93
K_2O = 2.37
Na_2O = 3.08
P_2O_5 = .17
Mn^3O^4 = .92
H_2O = 1.33 Sp. gr., 2.89.[1]
98.37

On comparing this with analyses of other syenites, it is found to contain about the average amount of SiO_2, to be low in Al_2O_3, but unusually high in magnesia and lime, having of the two together over 17%, while most syenites contain only from 2% to 6%. In this respect it resembles Weed and Pirsson's shonkonite of the Highwood Mountains, Montana. In general, however, it quite closely resembles some of the finer grained augite syenites of Norway, described by Professor Brögger as occurring in connection with the nepheline syenites of the Christiania region, for which reason perhaps it would seem natural to associate it genetically with the well-known nepheline syenite of Beemerville, N. J. A careful search for other occurrences of the rock in the region about has failed to discover it.

The serpentines and talcs of Chestnut Hill are all of them associated with a system of faults which follows the trend of the ridge. Within a distance of two miles north and two miles south of Easton there are four distinct thrust faults, all of them of types described by Mr. Bailey Willis in his "Mechanics of Appalachian Structure" as occurring in "The District of Folding and Faulting of Virginia, Tennessee and Georgia."[2]

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[1] This analysis was made by Mr. Richard K. Meade, assistant in chemistry in Lafayette College, Easton, Pa.

[2] Thirteenth Annual Report, Part II, of the Director of the U. S. G. S. for the year '91–'92.

The first of these faults extends along the northwestern side of Marble Mountain and Chestnut Hill and constitutes the boundary line between the pre-cambrian and the post-Algonkian (**Plate XVI. *A-C.***). It is a typical break thrust fault. At *A* there is a branch fault given off which runs along the southeastern slope of Chestnut Hill to a point *B* where it appears to die out. It is along this branch fault *AB* which cuts, as it were, diagonally across the ridge that all the talc and serpentine deposits of the region, with one exception, occur.[1] It partakes here more of the nature of a stretched thrust and all of the rocks involved in the faulting are so sheared, stretched and profoundly altered as often to be recognized with difficulty. The granites, for example, have every particle of their feldspar constituent sheared into a stringy, almost fibrous variety of sericite, not a trace of the original feldspar remaining, while the quartz remains as lenticular or film-like patches but crushed almost to a powder. The hornblende alters for the most part to serpentine, in fact the richly hornblendic granites seem to furnish one source of serpentine. The calcite-dolomite beds shear to a slaty, foliated, talcose mass consisting of a mixture of talc, tremolite, serpentine, with occasional seams of tremolite (?) asbestos, imbedded in a fibrous carbonate of lime (aragonite?), the fibers of both minerals lying parallel to each other and normal to the walls of the seam; or without shearing, become changed to beds of nearly pure white tremolite. The phlogopite which is developed locally in large quantities in connection with these beds, sometimes in huge crystals a foot in diameter but usually in rather finely granular masses, alters quite uniformly to serpentine and constitutes the chief source of that mineral in the Easton quarries. Huge masses of it weighing many tons are removed from time to time, consisting quite wholly of phlogopite mica in different stages of alteration to serpentine. Locally these masses of phlogopite become changed to the very finest variety of "Royal" of "Victoria Serpentine" which occurs here in such abundance as to rival the famous Connemara quarries of Ireland and excite the wonder of men of lifelong experience in the quarrying of decorative stones. One variation of this phlogopite serpentine is exciting considerable interest among architects. It consists of numerous rose-colored dolomite crystals scattered in masses of serpentine, which mixture when sawn and polished presents a most exquisitely beautiful combination of colors. This particular variety has been called "Verdolite" (Contraction of Verd-antique and dolomite), by Mr. William B. Read, president of the company now owning the quarries. This company, known as "The Verdolite Company," was formed for the purpose of purchasing and operating the quarries lying in the northern half of the granite area on the southeast slope of Chestnut Hill ridge and designated on the sketch map (**Plate XVI.**) as quarries No. 2, 3 and 4. These are the important quarries of the region. From No. 3 (Richard's quarry so called) is taken the best quality of serpentine. This quarry is directly on the highway and within two miles of the Lehigh Valley R. R. station. Between 3 and 4, a few hundred feet up the hill lie heavy ledges of verdolite and two or three hundred feet farther takes one into quarry No. 4 (known as Williams' quarry). This last named quarry has been excavated in a nearly pure tremolite rock which lies in heavy beds nearly 50 feet thick and dipping south under granite, which constitutes the hanging wall and lying on granite and gneiss to the northward. Evidently this rock has been faltered into its present position by thrusts from the south. The shearing to which it has been subjected has partially altered the tremolite to talc along the shearing planes, which rock has for years been quarried and ground for commercial purposes. Scattered through this finely crystalline, sometimes massive white tremolite rock, are seams and irregular aggregations of what was originally phlogopite or pyroxene, now altered thoroughly to a beautiful apple-green serpentine (Williamsite) which contrasts beautifully with the white tremolite. The relation of the tremolite to the serpentine and verdolite, in fact the relation and occurrence of all of the rocks under discussion, can be seen in Fig. 5 which is constructed along section line II. From fault line *AB* are given

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[1] The principal occurrences of talc and serpentine are indicated by a widening of the fault lines along which they occur and quarries from which they have been taken are numbered 1–7.

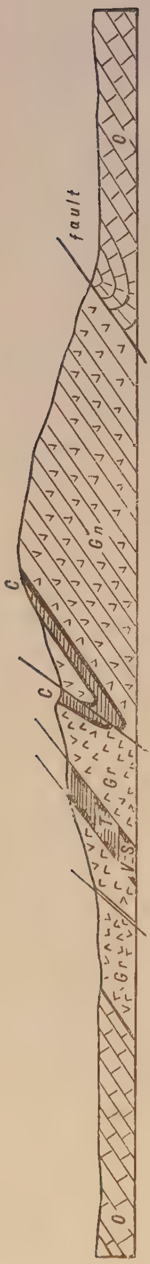

Fig. 5 Section No. 11, taken diagonally across Chestnut Hill at its eastern end. *O* = Post-Algonquin dolomites; *gr* = granite; *T* = tremolite beds with included Verdolite (*V*) and Serpentine (*S*); *gn* = pre-Cambrian gneiss with interstratified calcite-dolomite beds (*C*).

off two well defined and a third more poorly defined branch faults which intersect the granite, along the northernmost of which occur quarries 3 and 4. Here as explained the tremolite (*T*) beds lie dipping to the south between two granite walls. Along both the hanging and the foot wall, in close proximity to the granite, have developed (by infiltration of silica from the granite?) large quantities of phlogopite, under the hanging wall mixed with pink dolomite and constituting verdolite (*V*), on the foot wall altered to royal serpentine (*S*). More or less serpentine is found scattered through the tremolite. The serpentine as usual is not continuous but occurs in irregular masses varying from a few pounds to many tons in weight.

One other occurrence of talc should be mentioned, viz., that at 6, along the northern boundary of the augite syenite. It lies on the fault M. N. and is developed on the contact of the augite syenite on the post-Algonkian dolomite. The best of it constitutes the finest quality to be found in the region. Its origin, as it would seem from the manner of its occurrence, is different from that at the other localities. Here the post-Algonkian dolomites seem to have been the rocks to suffer change, the augite syenite remaining perfectly fresh and unaltered throughout, while the change from talc at the contact outward towards the dolomite is a gradual one. With the exception of a few cubes of iron pyrites, the entire product of the metamorphosis here is talc, there being no serpentine and no tremolite.

One point more should be mentioned regarding the occurrence of the tremolite beds in the Anthony's Nose granite area. After the formation of the fault *AB*, which cut diagonally across the pre-Cambrian ridge, the two dislocated ends, viz., Chestnut Hill on the southwest and Marble Mountain on the northeast seem to have been thrust by each other along the fault plane *AB*, the tremolite beds as well as the Anthony's Nose granite on the southeastern slope of Chestnut Hill being made to override the under thrust end of Marble Mountain in a series of thrust faults by which the tremolite beds became faulted in between granite walls, while the tremendous shearing to which the rocks were subjected brought about the alterations which have been described. That there has been crustal shortening in a direction at right angles to the principal folding is shown by a series of more or less parallel faults running at right angles to the series already described. In the southern limits of the city of Phillipsburg are two thrust faults which hade to the east, and which bring the pre-Cambrian gneisses to the surface in two masses separated by about thirty feet of post-Algonkian dolomite. The Pennsylvania Railroad in traversing this mass has blasted all the way through in the dolomite, being the line of least resistance, and leaving either wall of the cut as gneiss. Two other faults cutting at right angles across the southwestern end of Chestnut Hill can be made out. The force producing this transverse series of faults could be called into requisition in explaining the thrusting by each other of the dislocated ends of the Chestnut Hill ridge and at the same time the curved branching thrusts which intersect the granite.

LAFAYETTE COLLEGE, EASTON, PA., January, 1900.

PLATE XVI.

PLATE XVI

Sketch map of the vicinity of Easton, Penna., showing the occurrence of serpentine and talc and their relations to the main geologic features of the region.

gn = pre-Cambrian gneiss. gr = granite. xxx = augite syenite.

The principal occurrence of talc and serpentine are at points numbered 1 to 7 and are represented by thickenings of the fault lines.

A–B, etc., are fault lines.

I and II are lines along which sections are taken. See figs. 4 and 5 on pages 420 and 426 of text.

[Annals N. Y. Acad. Sci., Vol. XIII, No. 7, pp. 431–516, Feb. 12, 1901.]

RECORD OF MEETINGS

OF THE

NEW YORK ACADEMY OF SCIENCES

JANUARY, 1900, TO DECEMBER, 1900

RICHARD E. DODGE

Recording Secretary

[ANNALS N. Y. ACAD. SCI., XIII, No. 7, pp. 431--516, Feb. 12, 1901.]

RECORDS OF MEETINGS

OF THE

NEW YORK ACADEMY OF SCIENCES.

January, 1900, to December, 1900.

RICHARD E. DODGE, *Recording Secretary.*

SECTION OF BIOLOGY.

JANUARY 8, 1900.

Section met at 8:15 P. M., Professor F. S. Lee presiding. The minutes of the last meeting of Section were read and approved. The following program was then offered:

David Griffiths, STRUCTURE AND DEVELOPMENT OF THE SORDARIACEÆ.

F. S. Lee, THE SURVIVAL OF MUSCLE AFTER SOMATIC DEATH.

Wm. J. Gies, THE INFLUENCE OF PROTOPLASMIC POISONS ON THE FORMATION OF LYMPH.

Bashford Dean, ON THE EGG OF THE MYXINE GLUTINOSA.

F. B. Sumner (By Title), KUPFER'S VESICLE IN RELATION TO GASTRULATION AND CONCRESCENCE.

SUMMARY OF PAPERS.

Mr. **David Griffiths** spoke of the structure of certain species of the Sordariaceæ and briefly reviewed the work which has been done on the group. Certain species were taken as types of the principal genera, and their life history traced; *Sordaria finicola*, *Podospora coprophila*, *Hypocopra equorum* and *Sporormia intermedia* being spoken of specially. Some time was devoted to a discussion of the much mooted question of fertilization in this and kindred groups. The principal methods of spore distribution were outlined.

Professor **Frederic S. Lee** said that the duration of the life of voluntary muscle in mammals after the death of the individual has not been well known. Under the author's direction, Messrs. Adler and Bulkley have been investigating this in cats and rabbits. In each experiment the animal was killed, a particular muscle was excised and stimulated by electric shocks at five-minute intervals and the resulting contractions were recorded. The muscles used were the *soleus* (deep red) and the *tibialis anticus* (pale). Each survived several hours, the maximum for the red muscle being 14 hours and 37 minutes, and for the pale 12 hours and 20 minutes. It is known that in comparison with white muscle-fibers red fibers contain relatively more sarcoplasm, which is nutritive in function, and relatively less fibrillar substance, which is the contractile part. This may perhaps account for the longer survival of the red muscle. So far no constant difference in duration has been observed between the cat and the rabbit. In both the red and the pale muscle the decrease of irritability was gradual, but occasionally in the *tibialis* there was a sudden fall at the end of about one hour, the irritability then continuing at a low ebb for hours, but with a gradual decline. The sudden fall may have been due to the early death of the white fibers, which, intermingled with red ones, occur in the pale muscle. Besides the theoretic interest, the above results have a practical bearing, since they show that mammalian muscle can readily be used for experimental purposes in the physiological laboratories. This is now being done at Columbia University.

Dr. **William J. Gies** reported upon the changes which may occur in lymph after the administration of protoplasmic poisons. Quinin did not interfere with the usual influence of dextrose, although it did suppress the action of leech extract. The results with dextrose, therefore, indicate that the increase in the quantity of lymph following its injection in large quantity is due mainly to physical factors. In the case of leech extract, on the other hand, there is an interference with the action of the physiological factors that appear to be responsible for the changes usually brought about by this lymphagogue. That the increase in the amount of lymph after large quantities of dextrose have been injected is not due primarily to increased capillary pressure, as is held by Cohnstein and Starling, was shown in one of the experiments in which quinin caused the death of the animal, and yet from which the lymph continued to flow for three hours. After injecting arsenic, which is said very greatly to increase the permeability of the blood vessels, especially those of the portal system, there was little in the flow and character of the lymph resembling the usual effect of lymphagogues. It appears, therefore, that Starling's hypothesis of increased capillary permeability does not fully account for the action of lymphagogues, and that the mechanical theory of lymph formation fails as long as it does not explain the most striking phenomena of the process—those following the injection of Heidenhain's lymphagogues or Asher's 'liver stimulants.' The physiological theories of Heidenhain and Asher would explain them.

Dr. **Bashford Dean** described the condition in seven eggs which he had received from Professor A. E. Verrill. These had been collected in 1880 on the Newfoundland banks in water of 90 and 150 fathoms. The egg membranes were regarded as more specialized than those of Bdellostoma.

Francis E. Lloyd,
Secretary.

SECTION OF GEOLOGY AND MINERALOGY.

January 15, 1900.

Section met at 8:15 P. M., Mr. G. F. Kunz presiding. The minutes of the last meeting of Section were read and approved. The following program was then offered:

F. B. Peck, On Serpentines and Talcs in Vicinity of Easton, Pennsylvania.

J. J. Stevenson, C. E. BERTRAND'S THEORY RESPECTING THE ORIGIN OF CERTAIN COALS.

H. Ries, NOTE ON OCCURRENCE OF ALLANITE IN THE YOSEMITE VALLEY.

The following report was presented by Professor **J. J. Stevenson,** in behalf of the Committee appointed November 20, 1899 in reference to the death of Sir J. William Dawson, of Montreal. On motion of Professor D. S. Martin, the report was adopted.

J. William Dawson was born in Pictou, Nova Scotia, October 13, 1820; educated at Pictou College and Edinburgh University. Upon his return to Nova Scotia he was chosen Instructor in Natural History by Dalhousie College, and shortly afterward was appointed Superintendent of Instruction for the Province. When thirty-five years old he became Principal of McGill University, Montreal, then a struggling corporation, with no endowments, few professors, and a wretched equipment. Through his efforts, the struggling college developed into a university with equipment in many respects unsurpassed, with a large corps of professors, an enthusiastic body of students, and a generous endowment.

His contributions to geology are of the first rank. The store of facts accumulated during his term as Superintendent of Instruction was published under the title of ACADIAN GEOLOGY, a volume of about one thousand pages. In later years much of his study was given to palæobotany; we are indebted to him for the discovery of many of the earlier forms of land plants, and for the elucidation of many matters respecting relations of Palæozoic and Mesozoic forms. The phenomena about Montreal led him to investigate Pleistocene problems; his numerous papers upon such questions were summarized in a volume published in 1893.

Sir William's labors were incessant. He published many volumes on topics more or less related to geology; he was active in efforts to foster science, to advance the interests of higher education, and to improve the condition of his fellows. He was a consistent Christian, living his belief, respected and beloved by all who had dealings with him. Honors came to him abundantly; he was President of both the American and the British Association, as well as of the Geological Society of America, and the Royal Society of Canada.

Feeble health came to him in 1892, and soon necessitated the relinquishment of his university duties. Strength never returned to him; but he failed gradually until on November 19, 1899 he passed away, leaving an untarnished name, and a record which is one of the brightest. His memory will be cherished as that of a conscientious man, and an unselfish worker in science.

J. J. STEVENSON,
Chairman.

The Chairman called attention to the coming meeting in Paris this year, of the Eighth Session of the International Geological Congress; described the proposed excursions, and suggested the earnest coöperation of the Section by delegates, contribution of papers, and financial aid. On motion by Professor J. F. Kemp, the matter of representation of the Academy was referred to the Council for action.

SUMMARY OF PAPERS.

In the discussion that followed the paper by Professor **Peck,** Professor **Kemp** stated that in the talc deposits on the west side of the Adirondacks, described by Professor Smyth, the derivation of the talc had been attributed to the magnesian limestone or intrusion of a magnesian silicate rock. Professor Peck replied that he considered the tremolite rock to be due to the alteration of a siliceous dolomite, the talc, possibly to the interchange of silica from the Pre-Cambrian gneisses, and magnesia from the adjacent dolomite limestone. The serpentine and "viridolite" had indeed been subjected to much shearing and fracture, but had been solidly recemented, so that they could be quarried out in large blocks, free from cracks, sometimes of twenty tons weight, in the case of the "viridolite."

In the discussion of Professor **Stevenson's** paper, Professor **F. E. Lloyd** remarked that the cells of algæ, to whose accumulation Bertrand and Renaud mainly attribute the formations of these coals, are exceedingly delicate and often mucilaginous. Those of *sphagnum* are much thicker, solid and woody, and yet a large quantity of this is required to produce much deposit of carbonaceous matter in swamps.

The chairman inquired whether freezing or the introduction of silty waters might cause the precipitation of ulmic acid referred to by these authors. Professor Stevenson stated that ulmic acid so precipitated would tend to carry down suspended matters and to clear the waters.

Dr. **Ries** stated that while in the Yosemite Valley in September, 1899, his attention was attracted by a black, coaly looking mineral in the pegmatite veins on the northwestern side of the valley. On closer inspection the mineral proved to be allanite, and as it has not yet been recorded from this region, it seems of interest to note the fact.

The rocks forming the walls of the Yosemite are a grano-diorite, according to Turner (17th Ann. Rep. U. S. G. S., Pt. I, p. 710). Traversing this in many directions are veins of pegmatite, which are sometimes straight and unbroken, at others curved, branched, or even broken into. These pegmatite veins are very prominent on the face of El Capitan and also in the rock forming Eagle Peak. It was in the talus at the foot of the latter that the allanite was found, and while the mineral was at times abundant in the pegmatite blocks, still none of it was noticed in the grano-diorite. In only one instance was a distinctly bounded individual found, and on this a combination of orthopinacoid and base were recognizable. The other specimens were irregularly bounded grains that varied from a sixteenth to a quarter of an inch in diameter.

In addition to the quartz, muscovite and orthoclase present in the pegmatite, there were a number of radiating masses of epidote, which were evidently of primary origin; but in two instances the epidote occurred as a coating on hornblende and then seemed to be secondary. None was found in association with the allanite.

In conclusion it may be said that it is interesting to find that allanite is evidently not the rare mineral that it was formerly considered to be, and that a careful watch is beginning to show its presence at many localities in the United States.

ALEXIS A. JULIEN,
Secretary.

SECTION OF ANTHROPOLOGY AND PSYCHOLOGY.

JANUARY 22, 1900.

Section met at 8:15 P. M., Dr. Franz Boas presiding. The name of one candidate for resident membership was read and referred to the Council according to the by-laws. The following program was then offered:

Clark Wissler, SOME PHENOMENA OF INDIRECT VISION.

J. McK. Cattell, ON RELATIONS OF TIME AND SPACE IN VISION.

E. P. Buchner, ON NUMBER FORMS.

SUMMARY OF PAPERS.

Mr. **Wissler** described experiments that were made by exposing small letters or numerals in the indirect field of vision, while the attention of the observer was fully occupied with objects in the direct field. The subjects were not conscious of seeing the characters presented in the indirect field, indeed, one of the subjects whose results was reported did not know until several tests had been made that the characters were there at all. In spite of this failure to receive conscious expressions from the letters and figures, two subjects were found who could by association and afterwards by memory, give in a large number of cases the correct numeral or letter. These subjects made their associations in the form of visualized images. Many of the errors made were similar to those made in normal vision. Thus, *c* was mistaken for *o*, *35* for *55*, etc. It was held that the experiments suggest a relation between normal phenomena and the abnormal as seen in the hysterical eye, and that they point out a way to a more complicated experimentation in induced automatic movements.

Professor **Cattell's** paper described experiments on the perception of moving surfaces, which show that a time series may be perceived as a spatial continuum, and explained that the same phenomena held in the ordinary vision of daily life. Although the eyes, head and body are in continued movement, and the images on the retina are constantly shifting, the field of vision appears to be distinct and stationary. Thus, if one glances along a row of books, images follow one another on each retinal element in rapid succession, but these successive and rapid changes result in the perception of a space continuum, *all* the objects being distinct and arranged side by side.

Professor **Buchner** described, with the aid of sketches, the fixed visualizations experienced since childhood by a woman 35 years of age. There are three distinct, uncolored, tridimensional forms. The first is half fan-like in shape, lying almost entirely to the left of the mental point of regard, and includes the numbers from 1 to 100. The second includes the names of eight days, from Sunday to Sunday. The third has the names of the twelve months from January to December. The paper pointed out the elements which must appear in any theory of the genesis of the phenomena to which this group belongs.

CHARLES H. JUDD,
Secretary.

PUBLIC LECTURE.

UNDER AUSPICES OF THE SECTION OF BIOLOGY.

JANUARY 29, 1900.

Professor **G. H. Parker**, of Harvard University, delivered a lecture on THE NEURON THEORY IN THE LIGHT OF RECENT DISCOVERIES.

The lecturer gave a summary of the development of our knowledge of the histological structure of the nervous system, and contrasted with the neuron theory as widely understood that of Apathy's which declares the absolute continuity of the nervous system by means of the fibrillæ in the nerve cells and fibers as demonstrated by his method of technique. The lecture was closed by a criticism of Apathy's interpretation of his preparations.

Francis E. Lloyd,
Secretary.

BUSINESS MEETING.

February 2, 1900.

Academy met at 8 P. M., Professor M. I. Pupin presiding.

The minutes of the last business meeting were read and approved.

The Secretary reported from the Council as follows:

The following nominations of officers for the ensuing year, drawn up in accordance with the rules:

President, Robert S. Woodward.

First Vice-President, Charles A. Doremus.

Second Vice-President, Franz Boas.

Corresponding Secretary, William Stratford.

Recording Secretary, Richard E. Dodge.

Treasurer, Charles F. Cox.

Librarian, Livingston Farrand.

Councillors: Daniel W. Hering, Harold Jacoby, Frederic S. Lee, M. I. Pupin, Edward L. Thorndike, L. M. Underwood.

Curators: Harrison G. Dyar, Alexis A. Julien, George F. Kunz, Louis H. Laudy, William D. Schoonmaker.

Finance Committee: Henry Dudley, John H. Hinton, Cornelius Van Brunt.

The following nominations for Fellows were made in accordance with the by-laws, which say "candidates may be nominated by the Council, in writing, at a business meeting in January or February, and shall then be balloted for at the subsequent annual meeting":

Dr. W. S. Day,
James Douglas,
Jonathan Dwight, Jr.,
Marshal A. Howe,
Charles H. Judd,
E. G. Love,
Albert W. Trotter,
Henry S. Washington,
Theodore G. White.

The following nominations were made for Honorary and Corresponding Members, in accordance with the by-law that "Honorary and Corresponding Members may be nominated by the Council, in writing, at the business meeting in January or February, and elected at the subsequent Annual Meeting."

Honorary Members.

Julius Hann, University of Graz, Austria.
Henry A. Rowland, Johns Hopkins University.
Edward C. Pickering, Harvard University.
H. Poincaré, Sorbonne, Paris.
E. B. Tylor, Oxford, England.

Corresponding Members.

Professor A. DeLapparent, University of Paris; Paris, France.

Professor W. H. Holmes, National Museum, Washington, D. C.

Professor Kakichi Mitsukuri, Imperial University of Japan, Tokȳo.

Professor Geo. H. Parker, Harvard University, Cambridge, Mass.

Professor C. R. Van Hise, University of Wisconsin, Madison, Wis.

Professor Sho Watase, Tokȳo (Univ. of Chicago).

The Council has voted to appoint Professor J. J. Stevenson delegate to the International Geological Congress, to be held in Paris in 1900; and Professsor Charles A. Doremus delegate to the International Chemical Congress. The Academy has voted to subscribe to these Congresses.

The Council has voted to change the title of the Section of Astronomy and Physics, so as to read Astronomy, Physics and Chemistry.

The Anthropological Club, which has hitherto coöperated with the Academy in the meetings of the Section of Anthropology and Psychology, has been superseded by the American Ethnological Society, which has been revived. This Society will continue to coöperate with the Academy, as before.

Professor **Kemp,** as Chairman of the Reception Committee, has made the following report to the Council:

The American Museum authorities have kindly agreed to assign us one of the east wing rooms, 60 x 80, for Wednesday and Thursday, April 25th and 26th, at an expense to us for fittings, etc., as last year, not to exceed $200.

The following chairmen of sub-committees have consented to serve:

Anthropology, Franz Boas.
Astronomy, J. K. Rees.
Botany, D. T. MacDougal.
Chemistry, C. E. Pellew.
Electricity, Geo. F. Sever.
Psychology, J. McK. Cattell.
Geology and Geography, Richard E. Dodge.
Metallurgy, H. M. Howe.
Mineralogy, L. McI. Luquer.
Palæontology, Gilbert van Ingen.
Physics and Photography, William Hallock.
Zoology, C. L. Bristol.

The following candidates for resident membership, approved by the Council, were duly elected:

Charles L. DuVivier, 22 Warren Street.
Ludwig Riederer, 145 West 94th Street.
James S. Peabody, Mixed High School.
Francis B. Sumner, College of the City of N. Y.
F. C. Waite, University Heights, N. Y.

Richard E. Dodge,
Recording Secretary.

SECTION OF ASTRONOMY, PHYSICS AND CHEMISTRY.

FEBRUARY, 5, 1900.

Section met at 8:35 P. M., Professor M. I. Pupin presiding.

The minutes of the last meeting of Section were read and approved.

The following program was then offered :

J. K. Rees, REPORT ON NOVEMBER METEORS. (Read by Dr. S. A. Mitchell.)

J. K. Rees, THE VARIATION OF LATITUDE AND THE CONSTANT OF THE ABERRATION OF LIGHT, AS DETERMINED FROM SIX AND ONE-HALF YEARS OBSERVATIONS MADE AT THE COLUMBIA UNIVERSITY LATITUDE OBSERVATORY. (Read by Professor H. Jacoby.)

Geo. N. Bauer, THE PARALLAX OF μ CASSIOPEIÆ AND THE POSITIONS OF 56 NEIGHBORING STARS, AS DEDUCED FROM THE RUTHERFURD PHOTOGRAPHIC MEASURES.

SUMMARY OF PAPERS.

Professor **Rees,** in the first paper, stated that arrangements were made by the Columbia University Observatory to observe and photograph the meteors during the week of November 12–18, 1899. At West Point Dr. S. A. Mitchell, assisted by Messrs. Bauer and Jenkins, was provided with a Rowland concave grating and two cameras. No photographs however were obtained. At Bayport, L. I., Mr. C. A. Post placed his observatory and his services at the disposal of the Columbia Observatory staff. Six cameras and two telescopes were in use. On one plate in a camera provided with a Goerz lens, a photograph taken on November 15th, between 16 h. 9 m. 30 sec. and 16 h. 40 m. 44 sec. when pointed near Procyon, showed a meteor trail. Dr. Elkins of the Yale Observatory, will measure this plate.

A number of students and others watched for the meteors for the purpose of counting them at West Point, New York and Bayport, with the result as shown in the following table :

Date. 1899.	Time (Standard).	Number of meteors.	Leonids.
	(At West Point.)		
Nov. 12.	13 h. 15 m. to 15 h. 30 m.	5	1
13.	13 h. 10 m. to 14 h. 30 m.	1	0
14	12 h. 0 m. to 17 h. 0 m.	0	0
15.	11 h. 40 m. to 15 h. 30 m.	17	12
16.	13 h. 0 m. to 14 h. 30 m.	5	1
	(At New York City.)		
Nov. 15.	12 h. 55 m. to 18 h. 0 m.	68	68
	(by Misses Harpham, Proctor and Tarbox).		
Nov. 15.	14 h. 15 m. to 16 h. 45 m.	36	
	(by Mr. and Mrs. Woods).		
	(At Bayport).		
Nov. 15.	13 h. 57 m. to 17 h. 35 m.	39	

Professor Rees, observing casually while attending to the photographic apparatus at Bayport, observed a first magnitude Leonid at 15 h. 29 m. on November 15th, between the two lowest stars in the handle of the dipper. At 15 h. 39 m. he observed another first magnitude Leonid under Sirius. At 17 h. 15.5 m. a fine Leonid trail lasting 3 seconds was seen over Procyon. At 17 h. 30 m. a very bright Geminid was seen 20° south of Regulus.

Professor **Rees** stated in his second paper that observations of latitude had been made at the new site of Columbia University from April 24, 1893, to the present, and will be continued until May 1, 1900. The observers were Professors Rees and Jacoby, and Dr. H. S. Davis. A zenith telescope made by Waunscaff, of Berlin, was employed throughout. Its aperture is 80 mm. and its focal length is 1 meter. Four groups of stars were used having mean right ascensions of about 6 h., 14 h., 18 h., and 22 h. respectively. Each group contained 7 stars. Up to the present time, 6516 pairs have been observed on 758 nights. From the observations, a curve was drawn showing the latitude. This was compared with the curve required by Dr. S. C. Chandler's formula (*Ast. Jour.*, No. 446). From 1896 the observed epochs of maxima and minima seem to follow the computed time.

These observations give for the constant of aberration of light, the value

$$20''.464 \pm 0''.006.$$

Mr. **Bauer**, in his paper, stated that the star under consideration has a large proper motion and measurements of its parallax have been made by various methods and observers. The present determination is based on 28 Rutherfurd photographic plates, and the method of position angle was used in measuring them, as Professor Jacoby has already made a reduction using the method of distance. Eleven independent determinations were made, giving a value of

$$0''.238 \pm 0''.014.$$

Professor Jacoby found by the method of distance $0''.275 \pm 0''.024$, these results agree even better than might have been expected. In forming the catalogue of 56 stars about μ Cassiopeiæ, the usual corrections for refraction, precession, nutation, aberration, proper action, etc., were applied. Since the coördinates were measured in distance and position angle, these were then converted into difference of right ascension and declination. After finding the positions for the epoch 1872.0 the precession and secular variation were computed and tabulated.

Wm. S. Day,
Secretary.

SECTION OF BIOLOGY.

February 12, 1900.

Section met at 8 P. M., Dr. Bashford Dean presiding.

The minutes of the last meeting of Section were read and approved.

The following program was then offered :

J. H. MacGregor On the Development of the Skull in Ceratodus.

F. B. Sumner, Kupfer's Vesicle in Relation to Gastrulation and Concrescence.

G. S. Huntington, Some Muscle Variations of the Pectoral Girdle.

Summary of Papers.

J. H. MacGregor gave a brief preliminary report on the development of the skull in Ceratodus, the Australian lung-fish. The research is made conjointly with Professor Bashford Dean.

Only the early stages of the chondrocranium have as yet been studied; but it is noteworthy that these early stages show even closer resemblance to the amphibian skull than does the adult. The suspensorium is ante-stylic from the first, and the union of quadrate to cranium by ascending and otic processes is exactly as in urodele amphibia. The hyomandibular appears later than the body of the hyoid arch, and has no connection with the jaw. The trabulæ are widely separated, leaving a large ventral fontanelle, also an amphibian character. The palatopterygoid bar is almost entirely suppressed. The one character which is entirely fish-like is the otic capsule.

Dr. **Sumner's** paper brought out the following points:

I. The generally accepted account of gastrulation in the Teleosts, as proposed first by Götte, was shown to be incomplete, in so far as it failed to give a true account of the hypo-blast.

II. A view of Kupfer's vesicle was maintained, closely similar to that proposed by the great morphologist, after whom this structure has been named.

III. The present author has arrived, on purely morphological grounds, at a view of concrescence identical with that proposed by Kopsch on the basis of the latest experimental work.

Dr. **Huntington's** paper dealt specifically with the retro-clavicular group of supernumerary muscles, for the purpose of determining their mutual relationship and common derivation. The new muscle, here described for the first time, completes a series of retroclavicular aberrant muscles which represent different stages in migration and recession of the typical mammalian-sterno-chondro-scapularis. The members of this group appear, therefore, as myo-typical reversions representing persistent portions of this muscular plane, with secondary skeletal attachments, depending upon the degree of recession.

Francis E. Lloyd,
Secretary.

SECTION OF GEOLOGY AND MINERALOGY.

FEBRUARY 19, 1900.

Section met at 8:15 P. M., G. F. Kunz presiding.

The minutes of the last meeting of Section were read and approved.

The following program was then offered:

Henry S. Washington, THE MAGNET COVE LACCOLITH, ARKANSAS.

SUMMARY OF PAPER.

The structure of the complex is described and, from the evidence of the form of the area, the relations to the surrounding shales, the presence of an overlying zone of metamorphosed rock, the arrangement of, and the serial petrographical and chemical characters of the main rock types, with other minor points, the conclusion is drawn that the igneous complex is probably a laccolith, and certainly a unit; and that the main component abyssal rocks are not due to successive injections, as was suggested by J. F. Williams, but are the result of a differentiation *in situ* of the mass of magma.

The main rock types are described, some new analyses being given, and they are shown to form a regularly graded series of interesting rocks, ranging from basic jacupirangite, through ciotite-ijolite, typical ijolite, shonkinitic syenite and leucite-syenite, to foyaite. This serial, and common genetic character is shown both mineralogically and chemically. It is probable that the dikes of tinguaite and nepheline-porphyry are aschistic, while those of monchiquitic rocks are diaschistic.

The arrangement of the abyssal rocks is shown to differ radically from most other cases of differentiated laccolithic masses and dikes, in that there is progressive increase in acidity toward the periphery. One or two other instances of this are mentioned, the most closely analogous being the laccolith at Umptek in Kola (Finland).

An explanation of this is given, based on a process of fractional crystallization or freezing of the magma, and the idea applied to other cases. It is suggested that the laccoliths and similar magmatic masses, which have been studied, may be referred to three distinct types, the differences between which would be satisfactorily accounted for by the hypothesis.

In the ensuing discussion, Dr. Washington pointed out that the specimens of the rocks, represented by his analyses, had not been selected in a radial line, but in various directions at increasing distances from the central mass of basic constitution.

The following specimens were exhibited by the Chairman:

Corundum from Raglan Township, Ontario, Canada.

Variously colored sapphires from a new locality, Clear Creek, Granite County, Montana.

Corundum from a serpentine dike at a new locality, Corundum Hill, Plumas County, California.

Professor **R. E. Dodge** announced the death of Dr. Hans Bruno Geinitz, on December 30, 1899. The Chairman briefly discussed the character and work of Dr. Geinitz, and, on motion, Professor Stevenson was appointed a committee to prepare a minute on this great loss to the Academy and to science.

Alexis A. Julien,
Secretary.

SECTION OF ANTHROPOLOGY AND PSYCHOLOGY.

February 23, 1900.

Section met at 8:15 P. M., Dr. Franz Boas presiding.

The following program was then offered:

Carl Lumholtz, Symbolism of the Huichol Indians.

A. L. Kroeber, Symbolism of the Arapahoe Indians.

F. Boas, The Growth of Children.

Summary of Papers.

Dr. **Lumholtz** stated that the Huichols are a small tribe of about four thousand souls living in the southwestern part of Mexico, on a spur of the Sierra Madre. Their country being difficult of access, they have been left comparatively untouched by civilization, and thus preserved their ancient beliefs and customs intact to the present day. The paraphernalia of the warrior of ancient times, *i. e.*, of the gods of the present race, furnish the principal symbolic objects by which prayers are expressed, and the most important of these articles is the ceremonial arrow left as a sacrificial offering in the temples and considered a carrier of prayers. It is painted and otherwise decorated with symbolic emblems, and attached to it are representations of other paraphernalia of the warrior, as the front shield and the back shield, the latter being also viewed as the mat or bed of the god. Frequently the object of the prayer is incorporated in an attachment to the arrow. The vivid imagination of the people makes them see analogies in the most heterogenous phenomena. They see serpents in the sky, the clouds moving through space, the wind sweeping over the fields, the rain falling down, even in their girdles and ribbons. Certain insects which appear during the wet season are identical with corn, and corn is identical with hikuli, and hikuli with deer. The same tendency to consider heterogeneous objects as identical may be observed in the fact that a great variety of objects are considered as plumes. Clouds, cotton-wool, the white tail of the deer, the deer's antlers, and even the deer itself are plumes, and the serpents are believed to have plumes. Naturally, much ambiguity is found, and there are few symbols that express always the same meaning; nor is an idea always expressed by the same symbol. Although this gives a certain individuality to the symbolic objects, we can always trace the connection between the thought to be expressed, and the symbol expressing it.

In Mr. **Kroeber's** paper it was shown with the aid of lantern slides that the decorative art of the Arapahoe Indians is throughout realistic (*i. e.*, pictorial) or symbolic. Geometric patterns occur, but rarely, and the general character of the art is suggestive rather of pictography. Symbols representing animal life, physical nature and abstract ideas predominate.

Professor **Boas** showed that a series of measurements of children repeated at annual intervals proves that the variations of growth must be interpreted as mainly due to acceleration and retardation of growth, combined with hereditary influences, which determine the amount of annual growth. It has shown that it is possible to determine the essential elements which determine the amount of annual growth by admission of regulated measurements. These result in a determination of (1) the relation between final development and development of any given period; (2) the typical development at a given period; and (3) the variability of the series in regard to period.

CHARLES H. JUDD,
Secretary.

ANNUAL MEETING.

FEBRUARY 26, 1900.

The Academy met for the Annual Meeting at 8:15, President Osborn in the chair, who opened the meeting with the following address:

Members of the New York Academy of Sciences:

You are welcome to the 81st annual meeting of the Academy. We must congratulate ourselves upon our increasing strength which we trust is keeping pace with the rapid development of the City of New York as a scientific centre. This is not an institution for popular scientific education—a duty we may well leave to the Schools, the Universities, the Museums, and the recently established scientific parks. Our main object is the centralization of the best scientific thought of the city. In cordial coöperation with the several other scientific societies, this object should constantly be kept in view. We meet for high thinking and the encouragement of research. The rise of this Academy in the esteem of the people of this city and of similar academies abroad, will depend, not upon our scientific organization, which we now believe to be well nigh perfect, thanks to the careful efforts of the last few years; but upon the scientific discoveries which are stimulated and made known here. We all stand for plain living. The votaries of science do not need an elaborate meeting place; but there is a certain stimulus in the scientific atmosphere of the historic associations which cluster around this Academy, which we shall lack until we secure a building of our own. We ask the intelligent people of this city, who owe everything they possess to the applications of science, for two large funds. First, an endowment fund for the publication of our researches; this fund should not be less than $60,000. This, in my judgment, is of more pressing importance than the building.

Secondly, we ask for a building fund for a suitable meeting place, which we propose to share with the other societies of the Scientific Alliance. To this fund one of our Patrons, Mrs. Esther Herrman, has already generously contributed.

Upon the whole the sections of the Academy have gained steadily in strength. We regret that the disbandonment of the Philological section became necessary. At the same time we appreciate the fact that the Anthropologists have recently organized an Ethnological Society, but will continue to hold part of their meetings with us; this branch of science, stimulated by the expeditions of the American Museum of Natural History, promises to be very strong. We have added Chemistry to the subjects covered by the Astronomical and Physical section.

During the past year I regret to say that some of our most distinguished Honorary Members have passed away. Among these are the veteran chemists, Professor Bunsen, of Heidelberg, and Sir Edward Frankland, Foreign Secretary of the Royal Society of London. We also mourn the loss of Sir William Dawson, the eminent geologist and palæontologist of Canada; and of Professor Geinitz, who long held a leading position in Germany. I must refer to the death of Sir William Flower, Director of the British Museum of Natural History, as a personal loss, for I had the pleasure of esteeming him among my warm friends. He rendered great services to the study of mammals and to the development of scientific museums.

In retiring from the Presidency, I desire to express my warm appreciation of the honor you have conferred upon me, and I trust you will give equally cordial support to my successor.

The minutes of the last Annual Meeting were then read and approved.

No report of the Corresponding Secretary was given.

The report of the Recording Secretary, which is filed herewith, was then read and approved.

The accompanying report of the Treasurer was read and referred to the Finance Committee.

The accompanying reports of the Librarian and Editor were accepted, and votes of thanks passed for the work of the Librarian and Editor.

The following nominations for Honorary Members were read, as selected by the Council:

Julius Hann, Ph.D. Professor of Meteorology, University of Graz.

Edward Charles Pickering, LL.D. Paine Professor of Practical Astronomy, Harvard University.

Jules-Henri Poincaré, F.R.S. Professor of Mathematical Physics, Faculty of Sciences, Paris.

Henry Augustus Rowland, LL.D. Professor of Physics, Johns Hopkins University.

Edward Burnett Tylor, D.C.L., LL.D., F.R.S. Professor of Anthropology, University of Oxford.

Brief addresses in reference to the candidates were made as follows:

Dr. Hann, Professor Richard E. Dodge.

Professor Pickering, Professor J. K. Rees.

Professor Poincaré, Professor Woodward.

Professor Rowland, Professor Hallock.

Professor Tylor, Dr. Franz Boas.

The Secretary was then empowered to cast one ballot for the list as read.

The following list of corresponding members was nominated by the Council, and the Secretary was instructed to cast one ballot for their election, which was done.

Albert De Lapparent, Professor of Geography, École Libre de Hautes Études, Paris.

William Henry Holmes, Curator, United States National Museum, Washington, D. C.

Kakichi Mitsukuri, Ph.D., Professor of Zoology, Imperial University of Tokȳo.

George Howard Parker, Ph.D., Associate Professor of Zoology, Harvard University.

Charles Richard VanHise, Ph.D. Professor of Geology, University of Wisconsin,

Sho Watase, Ph.D., Professor of Histology, Imperial University of Tokȳo.

The following list of resident members was nominated as Fellows, by the Council, and the Secretary was instructed to cast one ballot for their election, which was done.

Dr. W. S. Day, Secretary Section of Astronomy, Physics and Chemistry.

James Douglas, Pres. American Institute of Mining Engineers.

Jonathan Dwight, Jr., Ornithologist.

Dr. Marshall A. Howe, Curator of Columbia University Herbarium.

Professor Charles H. Judd, Professor of Psychology, N. Y. University.

Dr. E. G. Love, Entomologist.

Alfred W. Trotter, Civil Engineer and Mining Expert.

Dr. Henry S. Washington, Petrographer.

Dr. Theodore G. White, Palæontologist.

The President then appointed as tellers, Mr. Kunz, Professor Lloyd, and Dr. White, to take charge of the election.

Dr. E. G. Love was nominated as Curator in place of Mr. W. D. Schoonmaker, who was not eligible.

Ballots were distributed, votes received and counted, and the following list of officers elected.

President—Robert S. Woodward.

First Vice-President—Charles A. Doremus.

Second Vice-President—Franz Boas.

Corresponding Secretary—William Stratford.

Recording Secretary—Richard E. Dodge.

Treasurer—Charles F. Cox.

Librarian—Livingston Farrand.

Councillors—Daniel W. Hering, Harold Jacoby, Frederic S. Lee, M. I. Pupin, Edward L. Thorndike, L. M. Underwood.

Curators—Harrison G. Dyar, Alexis A. Julien, George F. Kunz, Louis H. Laudy, E. G. Love.

Finance Committee—Henry Dudley, John H. Hinton, Cornelius Van Brunt.

The President-elect then took the chair, and after a brief address, introduced the retiring president, who gave his presidential address, entitled: THE GEOLOGICAL AND FAUNAL RELATIONS OF EUROPE DURING THE TERTIARY PERIOD, AND THE THEORY OF THE SUCCESSIVE INVASIONS OF THE ETHIOPIAN FAUNA.

The Academy then adjourned.

RICHARD E. DODGE,
Recording Secretary.

REPORT OF THE TREASURER.

February 26, 1900.

RECEIPTS.

Balance on hand, as per last annual Report		$1,489.85
Income, Permanent Fund	$420.14	
" Publication Fund	90.00	
" Audubon Fund	89.86	600.00
Life Membership Fees		200.00
Initiation Fees		80.00
Annual Dues, 1895	10.00	
" 1896	10.00	
" 1897	65.00	
" 1898	150.00	
" 1899	2,340.00	
" 1900	50.00	2,625.00
Total Receipts		$4,994.85

DISBURSEMENTS

Cost of Publications,	$1,250.45	
Less received from sales	130.85	
		$1,119.60

Rent of Rooms		440.00	
Expenses of Officers:			
Recording Secretary	$363.09		
Librarian	278.48		
Treasurer	43.81	685.38	
Sectional and General Expenses		28.11	
Cost of Lectures		66.48	
Cost of 6th Annual Reception		366.17	
Preliminary Expenses of 7th Annual Reception		50.00	
			$2,755.74
Balance now on Hand			$2,239.11

DETAILS OF PERMANENT FUND.

Balance, as per last Annual Report	$1,468,68
Life Membership Fees rec. during year	200.00
Initiation Fees, rec. during year	80.00
Balance now on hand, for Investment	$1,748.68

DETAILS OF GENERAL INCOME ACCOUNT.

CREDIT.

Received from Annual Dues	$2,625.00
Income of Permanent Fund	420.14
" Publication Fund	90.00
	$3,135.14

DEBIT.

Deficiency brought over from last year	$281.55	
Net Cost of Publications	1,119.60	
Rent of Rooms	440.00	
Expenses of Officers	685.38	
Sectional and General Expenses	28.11	
Cost of Lectures	66.48	
Cost 6th Annual Reception	366.17	$2,987,29
Balance, surplus		$ 147.85

SUMMARY.

Balance to credit of Permanent Fund...	$1,748.68
" " " " Audubon Fund....	100.00
Total, awaiting investment......	$1,848.68
Accumulated Income of Audubon Fund awaiting appropriation by the Council.	292.58
Balance to credit of General Income a/c available for future expenses........	147.85
	$2,289.11
Less, amount advanced for Preliminary Expenses of 7th Annual Reception.........................	50.00
Balance, cash on hand.........	$2,239.11

It appears from the foregoing figures that the total expenses of the Academy for the year were $429.40 less than its available income, so that a deficiency of $281.55 was wiped out, and a surplus of $147.85 created in General Income Account.

ASSETS.

Cash in Bank		$2,239.11
Investments in Bonds and Mortgages @ 5%:		
a/c Permanent Fund	$8,402.75	
a/c Publication Fund	1,800.00	
a/c Audubon Fund	1,797.25	12,000.00
Annual Dues in Arrears:		
For 1896	40.00	
" 1897	130.00	
" 1898	200.00	
" 1899	450.00	820.00
Total........................		$15,059.11
Amount last year..................		14,109.85
Gain for year		$ 949.26

C. F. Cox,
Treasurer.

REPORT OF THE RECORDING SECRETARY.

FEBRUARY 26, 1900.

The last Academy year has been one of progress, but has not been marked by any striking events that make it noteworthy. The attendance at the meetings has continued pleasing, and in every way the work of the Academy has continued along the lines previously adopted.

During the last year there have been seven meetings of the Council, six Business meetings, thirty Sectional meetings, four Public Lectures, and one Public Reception. At the Sectional meetings and Lectures there have been presented a total of eighty-two papers, which may be classified as follows:

Anthropology 7.
Archæology 3.
Astronomy 5.
Botany 2.
Electricity 1.
Descriptive Geology 5.
Economic Geology 3.
Mechanics 2.
Mineralogy 3.
Ornithology 1.
Palæontology 6.
Petrography 5.
Philology 4.
Physics 8.
Physiography 1.
Physiology 1.
Psychology 9.
Unclassified 1.
Zoology 15.

There are at present a total of 333 members, and there have been elected during the last year 16, of whom 7 have not yet qualified. There have unfortunately been 13 resignations. It is with regret, also, that the Academy records the death of seven Honorary Members.

There are pending for consideration this evening five nominations for Honorary Members, six for Corresponding Members, and nine for Fellows.

The Annual Reception and Exhibition was held in April, in the American Museum of Natural History, and like its predecessors, was extremely successful. For the first time since the Reception has been held in the American Museum it was possible to have an unoccupied room, whereby there was no confusion between the Academy and Museum exhibits. The same plan will be followed during the coming year. The Academy feels that it owes a great deal to the President and Trustees of the American Museum of Natural History, for their kindness and courtesy in allowing the Annual Reception to be held in the Museum, under such favorable auspices, and at such a moderate expense to the Academy.

A few changes have been made during the last year in the organization and management of the sections. It is with regret that the Academy has seen the Sub-Section of Philology discontinued because of lack of public interest in the meetings. It is with pleasure that the Council has added to the field of operations in the Section of Astronomy and Physics by incorporating therewith work in Chemistry. Mention should also be made of the extremely satisfactory and pleasing work which is being accomplished by the Section of Anthropology and Psychology.

During the last two years the Anthropological Club has been coöperating with the Section of Anthropology and Psychology in their meetings. This Club has lately been superseded by the Ethnological Society, which has been revived. The Ethnological Society will continue to coöperate with the Section of Anthropology and Psychology, and it is hoped that strength may be acquired by both organizations through this mutual assistance.

The Council feels that the success and increased interest evident in the meetings since the removal of the meeting place to this building is a very pleasing feature in the Academy's work. Almost without exception the meetings of the different sections have been individually and as a whole largely increased in attendance during the last year and a half. Many faces that were never seen at the other meeting places are now regularly seen at the sections that most interest them.

The work of the Recording Secretary's office has been systematized, and in many ways improved during the last year, so that the necessary and frequent details are managed more efficiently and with less expenditure of energy and time.

The needs of the Academy remain as a year ago, many. The particular need is for a larger publication fund, which will make it possible for the Academy to publish a number of large and important papers which it is now obliged to refuse, owing to a lack of funds. A publication fund would be one of the best endowments that the Academy could receive.

The other great need of the Academy, as it is the need of all the other scientific societies in the city, is a permanent meeting place, at which the library could be housed, and where members would have freedom at all times. The Academy trusts that the beginning of a fund of this sort, so kindly started last year by Mrs. Herrman, may be increased in the near future.

No changes in the policy or plan of procedure of the Academy are anticipated for the coming year.

Respectfully submitted,
RICHARD E. DODGE,
Recording Secretary.

REPORT OF THE LIBRARIAN.

FEBRUARY 26, 1900.

The Library of the Academy consists in round numbers of 9,000 volumes. The total number seems a small one; but it will be recalled that the value of the Library consists largely in its sets of scientific periodicals. Hardly five per cent. of the volumes are in separate title. On the shelves of the Library are now about 8,500 volumes; the remainder, consisting of Consular, Signal and Patent Offices reports, educational, health, and statistical State publications, have been placed for the present, at least, in storage; they are so disposed, however, that they are accessible on short notice. The following statistics may be added: Bound volumes, Quarto, 505; Octavo, 6,115. Unbound volumes, Quarto, 220; Octavo, 950.

At the beginning of his term of office, the Librarian found the room, 507 Schermerhorn Hall, provided with cases for the reception of the collection. The books, it will be remembered, had up to this time been stored in the basement of Schermerhorn Hall, pending the provision of the class rooms, and furnishings of Columbia University. His first duty, therefore, was to attend to the time-consuming work of unpacking the Library, arranging it on the shelves, revising the catalogue, and adjusting the entire matter of serial publications. The last-named task proved in many ways the most difficult, since owing to the moving of the University, the serial publications had accumulated since 1896 or 1897. Recalling that the Academy has upwards of 800 Societies on its exchange list, it is easily seen that the mass of exchanges was represented by a small mountain of periodicals in all languages, in almost hopeless confusion. The receipt of the exchanges had also to be acknowledged. At the present time the following items are noted as having been accomplished:

The volumes have been arranged on the shelves, the latter have been numbered, and all serial publications—the greatest part of the Library—can be readily found by reference to the shelf numbers now placed in the card catalogue. The card catalogue has been carefully revised, it having been found that the subject and locality titles had been unsatisfactorily arranged. The room of the Library has been suitably lighted. One hundred volumes have been bound and added to the shelves. For the convenient grouping of the incoming periodicals, a large case has been prepared and the present stock of pamphlets (periodicals) has been classified and are in large part placed in order in this case. A geographical arrangement has been found most convenient. Suitable labels will be put in place, different colors representing different countries, so that the visitor can find the recent numbers with the least possible loss of time.

There are many things left undone which I intended to do. I had in mind the publication of a catalogue of the collection, to be sent to the members of the Academy. This I had hoped to bring up to date; but unexpected difficulties found in the classification of the periodicals have prevented me from carrying out the plan. I was also in hopes of having all separate pamphlets and odd volumes recorded by shelf numbers in the card catalogue. The most that I have succeeded in doing in the last matter is the arrangement of these volumes or pamphlets on definite shelves, according to their subjects, a grouping which will, I think, temporarily, at least, serve a useful purpose. Thus, the visitor who wishes to determine whether a separate book or pamphlet is in the library, say on the subject of Zoology, will be told that if an octavo he will find it in case 27, or if a quarto in case 41, shelves 1 and 2, or 4 and 6. If the book is, as is usually the case, entered in the card catalogue, the visitor will have no difficulty, I think, in thus securing his book with very little loss of time.

Respectfully submitted,

Bashford Dean,
Librarian.

REPORT OF THE EDITOR.

February 26, 1900.

The Editor desires to make the following report for the past Academy year:

Volume XII of the Annals, Part I, comprising 3 papers of 89 pages, with 4 figures, has been printed and distributed. Parts II and III of Volume XII will be issued together, making a total of 14 papers and about 600 pages in the complete volume. Of these numbers 4 to 9 have been issued as author's separates.

Six numbers, in all about 250 pages, are already in hand for printing in Volume XIII.

Volume II, Part I of the Memoirs, entitled "The So-Called Devonian Lamprey, *Palæospondylus gunni*, with notes on the systematic arrangement of the fish-like vertebrates," Bashford Dean, 4to, pp. 1–32; pl. I (litho), January 20, 1900, has been distributed; and Volume II, Part II, entitled "The Egg of the Hag-Fish, *Myxine glutinosa*," Bashford Dean (7 typewritten pages and 1 plate), is in press.

The following is the list of papers already issued as separates, soon to appear in the remaining parts of Volume XII. Arthur Hollick—" Some Features of the Drift on Staten Island, N. Y.," pp. 91–102 (July 7, 1899), pl. I (map); Richard Weil—" Development of the *Ossicula Audita* in the Opossum," pp. 103–118; pls. II and III (zinc) (July 7, 1899); Frederick J. H. Merrill—" Origin of the White and Variegated Clays of the North Shore of Long Island," pp. 113-116 (July 8, 1899); Hubert Lyman Clark—" Further Notes on the Echinodermata of Bermuda," pp. 117–138, pl. IV (zinc); R. P. Whitfield—" List of Fossils, Types, and Figured Specimens used in the Palæontological Work of R. P. Whitfield, showing where they are probably to be found at the present time," pp. 139–186 (Nov. 15, 1899); John Duer Irving—" A Contribution to the Geology of the Northern Black Hills," pp. 187–340; pls. V–XVI, text figures 5–20 (Dec. 18, 1899). The following papers also to appear in Volume XII, are still in press; author's separates have not been issued. Walter C. Kretz—" The Positions and Proper Motions of the principal stars in the Cluster of *Coma Berenices*, as deduced from measurements of the Rutherfurd Photographs," about 150 printed pages; W. M. Rankin—" The Crustacea of the Bermuda Islands, with notes on the collections made by the N. Y. University Expedition in 1897 and 1898"; about 40 pages text and plate XVII. Louis H. Gray—" Contributions to Avestan Syntax, The Conditional Sentence"; 30 printed pages. William E. Ritter—" Some Ascidians from Puget Sound"; collections of 1896; 30 pages text and three colored lithographed plates, nos. XVIII–XX. Records, about 40 pages.

The edition of the ANNALS has been increased from 1000 to 1250, and during the year the mailing list has been extensively revised and straightened out. There is necessarily some delay in the issuing of the papers, owing to the necessary slowness in reading the proof of certain articles; some changes to be made in the mode of publication with intent toward insuring regular time of appearance of the parts of the ANNALS is absolutely necessary.

The work of the Editor has on the whole progressed satisfactorily.

Respectfully submitted,
GILBERT VAN INGEN.
Editor.

BUSINESS MEETING.

MARCH 5, 1900.

Academy met at 8 P. M., President Woodward presiding.

The minutes of the last business meeting were read and approved.

The Secretary reported from the Council as follows:

That the delegates to the Scientific Alliance for next year were President Woodward, Mr. Cox and Professor Doremus.

That the Academy had voted to secure, if possible, photographs of the past presidents of the Academy, to be framed and hung in the Library.

That Professor Osborn had been elected a delegate to the International Congress of Geology.

The following candidate for resident membership, approved by the Council, was duly elected:

W. D. Matthew, American Museum of Natural History.

RICHARD E. DODGE,
Recording Secretary.

SECTION OF ASTRONOMY, PHYSICS AND CHEMISTRY.

MARCH 5, 1900.

Section met at 8:20 P. M., Professor M. I. Pupin presiding.

The minutes of the last meeting of Section were read and approved.

The name of one candidate for resident membership was read and referred to the Council according to the By-Laws:

The following program was then offered:

R. S. Woodward, AN ACCOUNT OF THE JUBILEE OF SIR GEORGE G. STOKES.

A. C. Longden, RESISTANCE OF THIN FILMS DEPOSITED BY KATHODE RADIATION. SELENIUM RINGS.

SUMMARY OF PAPERS.

The Jubilee, described by Professor **Woodward,** was held on the 1st, 2d and 3d of June, 1899, on the fiftieth anniversary of the professorship of Sir George G. Stokes at Cambridge. Stokes' most important scientific work was done between 1842 and 1855. In fluid motion he showed that the conditions under which the equations of motion were integrable, were the conditions that the motion should be irrotational. He made researches concerning the elastic solid theory of light. He made advances in the theory of physical geodesy. He showed that the shape of the earth's surface should determine the law by which gravity varied from place to place. He cleared up a good many obscurities in the work of Fourier in regard to Fourier series.

The Jubilee began with the Rede lecture, delivered by Professor Cornu of the École Polytechnique, on the "Wave Theory of Light," and its influence on modern physics. Beside dinners, garden parties, etc., the most important ceremonies were the presentation of addresses by the delegates representing about seventy institutions, and the conferring of the honorary degree of Doctor of Science upon Messrs. Cornu, Darboux, Michelson, Mittag-Leffler, Quincke and Voigt. At the dinner which ended the celebration, Sir George Stokes made a speech in the course of which he said that he wished he had done more scientific work, but that if he had, he might not have been there to celebrate his jubilee.

Mr. **Longden,** in the second paper of the evening described his method of depositing thin metallic films on glass, and showed some specimens. These films can be used as high resistances instead of the very expensive wire resistances ordinarily used. Films of gold or platinum can be deposited, which have not the lack of durability of alloys. At the same time, unlike the metals in the form of wire, they have very low positive or even negative temperature coefficients. The films are deposited from a kathode of the same material by the discharge of electricity through a vacuum, and can be deposited in any thickness desired, and of any metal, gold and platinum being however the most convenient. The speaker showed a gold film of varying thickness in different parts, the thickest part showing the green color like gold leaf when viewed by transmitted light, and the color varying through blue to violet as the film became thinner.

In the third paper the speaker stated that at the suggestion of Mr. C. C. Trowbridge, he had attempted to deposit a thin conducting film of selenium, but he was unsuccessful as the film deposited was non-conducting. He obtained, however, a film of varying thickness which exhibited the phenomenon of Newton's rings in a beautiful manner.

The section then proceeded to the election of sectional officers. The motion was made and passed to take an "informal" ballot. The informal ballot was taken. For Chairman, Professor Pupin received three votes, and Professor Hallock six votes. For Secretary, Dr. Day received nine votes. The motion was then made and passed that this ballot be regarded as the formal ballot. Professor Hallock was therefore declared elected Chairman and Dr. Day, Secretary.

The section then adjourned.

WM. S. DAY,
Secretary.

SECTION OF BIOLOGY.

MARCH 12, 1900.

Section met at 8:15 P. M., Professor F. S. Lee presiding. The minutes of the last meeting of Section were read and approved.

The name of one candidate for resident membership was read and referred to the Council according to the By-Laws.

The following program was then offered :

E. L. Thorndike, MENTAL LIFE OF ANIMALS.

D. T. Macdougal, SYMBIOSIS OF ROOTS AND FUNGI.

R. Ellsworth Call, The Newburg Mastodon and Its Associated Fauna.

Summary of Papers.

Dr. **Thorndike** described some of the features of the mental life of the monkeys, contrasting their behavior and abilities with those of other mammals. He presented evidence showing the importance of the use of the fore-limbs, delicate discrimination in vision, and incessant general activity as factors in the mental development of the monkeys. He also reported in detail some observations concerning their formation of various intelligent habits, which hint at a near relationship to the human methods of learning.

Mr. **Macdougal** stated that the roots of an extremely large number of plants form asssociations with fungi in such manner that a felt of hyphæ a millimeter or more in thickness covers the surface, or the fungus may penetrate the tissues and develop coils and clumps of hyphæ in the cortex, from which a number of tubes extend out into the soil.

Roots alone may absorb only minute quantities of the complex products of decomposition of organic matter, but fungi derive almost their entire supply from such sources. The union of the root and fungus result in the latter yielding some of the absorbed humous products to the higher plant. The fungus in turn receives more or less shelter and certain carbohydrates which it uses as food to advantage.

Associations of such symbiotic nature are followed by degenerations of the stele and of the general structure of the root stems, and leaves of the higher plant.

Dr. **Call** referred to the general geological structure of the region about Newburg, which is Hudson River group rock, for country rock, surmounted with a heavy deposit of glacial till. The remains of the mastodon which were under discussion were in the upper portion of the till, partially imbedded in it, and capped with from four to six feet of a black soil rich with vegetable debris. The locality is in a depression of considerable extent, and had, at one time, been a beaver dam, as was indicated by the numerous remains of beaver-gnawed sticks and logs, which were found during the excavations.

Associated with the mastodon bones were a number of species of fresh-water mollusca, among which the following were recognized: *Limnæa stagnalis*, Linn.; *Limnophysa humilis*, Say; *Physa heterostropha*, Say; *Planorbella campanulata*, Say; *Gyraulus parvus*, Say; *Valvata tricarinata*, Say; *Valvata sincera*, Say; *Amnicola limosa*, Say; and *Pisidium æquilaterale*, Prime. All but the species of *Physa* were abundant. The *Limnæa stagnalis* were very large, larger than are now found in recent stations.

The shell-marl was a later deposit than that in which the mastodon remains were found. The place was a peat bog, but never one of great extent nor of great depth.

None of the large leg bones of the mastodon have been found, and the small ones of but a single foot. The animal was not found at the place where it died, but where it had likely floated after partial dismemberment.

At the close of the scientific program, Prof. Patrick Geddes, of the University of Dundee, was invited by the Chairman to present a plan for the formation of an International Association for the Advancement of Science, Arts, and Education, the first assembly of which is to meet at Paris, 1900.

On motion of Professor E. B. Wilson, the thanks of the section were extended to Professor Geddes for his exposition of the plan, with the request that he communicate the matter formally to the Council of the Academy.

The application of Dr. M. A. Howe for the Newberry Fund Grant was read, and referred to a committee consisting of Professor F. E. Lloyd, Professor C. L. Bristol, and Dr. G. N. Calkins.

The election of sectional officers was, on the motion of Dr. G. N. Calkins, postponed one month.

FRANCIS E. LLOYD,
Secretary.

SECTION OF GEOLOGY AND MINERALOGY.

MARCH 19, 1900.

Section met at 8:15 P. M., Mr. Geo. F. Kunz presiding.

The following program was offered:

Henry B. Kümmel, THE PALISADES. Illustrated by lantern slides.

John C. Smock, ON THE PROTECTION OF THE PALISADES.

SUMMARY OF PAPERS.

A summary was read of the information thus far collected in regard to the Geology of the Palisades of the Hudson River, illustrated by numerous views, many of them taken by Mr. Prince, of Orange, N. J. Most of the details of the paper will be found in the 1897 Report of the State Geologist of New Jersey. Observers are nearly all agreed that the Palisades are an intrusive trap sheet, which has cooled at great depths. The basal contact is observable at 19 localities, in 15 of which the trap is unconformable upon the sandstone and shales beneath, and is penetrated by tongues of the latter, and in three is apparently conformable. The altitude of the lower contact increases from the south to the north, where it reaches 200 feet elevation. The upper contact is seen in six localities. At three of these, dikes penetrating the overlying shales occur at the contacts; in two the contact is unconformable, and in one conformable. In every instance the beds superjacent to the trap are metamorphosed. In no locality of the Palisades range proper does the upper contact of the trap show any of the characteristics of surface cooling. Well-borings at Fort Lee penetrate 875 feet of the trap, and the total thickness probably exceeds 950 feet, much erosion having taken place. Subsequent to deposition of the overlying sandstones the area was tilted, and the sandstone wasted away by erosion of many streams, the vacant channels of which are still present. The largest of these stream-gaps was one and a half miles wide, and is just north of the New Jersey State boundary. The cutting of gaps throughout the dissected tilted peneplain which remains was very uniform, and indicates that the former land level was 220 feet lower than the present. If this is the case, we have an instance of rivers beheaded close to their mouths. In addition to the wild beauty of the Palisades escarpment, the timber of this tract is the most luxurious and valuable of the State of New Jersey, although its area is much less than that of the pine groves to the south.

Professor **John C. Smock,** State Geologist of New Jersey, followed with an account of the efforts expended on the protection of the Palisades from devastation by quarrymen. Legislative prohibition of such destruction is retarded by (1) lack of interest in the matter on the part of residents in southern New Jersey; (2) prospects of the future commercial value of the riparian lands at the base of the cliffs, for purposes of shipping and manufacturing, which the removal of a portion of the cliffs would render available; (3) the present value to the State of its quarrying interests along the water front; (4) the income derived from riparian grants of these lands by the State to the quarrymen, which income is devoted to the maintenance of the public schools, the approximate value to the State for this purpose of the lands from Fort Lee to the State border being about one million dollars. This clash between the interests of the schools and the preservation of beautiful scenery is the most serious obstacle with which legislation against defacing the Palisades has to contend.

"In the face of these obstacles it is evident that the wholesale absorption of this territory for a purely sentimental object is impossible. The opposition to such a scheme could only be broken by years of fighting, and in the meantime the destruction of the cliffs and wooded slopes will continue with ever-increasing extent."

As a compromise, Professor Smock suggested that an interstate commission of New Jersey and New York lay out a driveway along the base of the Palisades, quarrying, manufacturing, and shipping interests to be confined to the water-side of the driveway, and the cliff side to be permanently preserved intact after the drive is completed. Edinburgh, Quebec, and Sterling were cited as exhibiting rocky heights whose grandeur was enhanced by the fringe of manufactories at their base, such buildings lending a basis to the eye by which to measure the proportions of the cliffs. Cliff defacement is also in progress upon the New York Palisades, where are the grandest wooded slopes and highest peaks. There is no need of encroachment on the cliffs in either State, for there are many other places where as good road material exists in equally great quantities, and can be mined at practically the same expense.

"Whatever is done should be done at once, or else we shall have lost a great part of the scenery which we wish to preserve, and this must be done without destroying, or coming in contact with the large public and private business interests that are involved."

In discussion Mr. **Kunz** voiced the sentiment that the opposition to legislation arose more with officials at Trenton than with residents of southern New Jersey, and felt that smoke and other nuisances from factory settlements along the cliff would be seriously detrimental. Were a restricted park created, the value of residential property would in a few years benefit the State many times over the value of the riparian grants. Railroad tunnels might be permitted a distance of a few miles apart, with commercial villages at their water front terminals. The stone from such tunnels would defray the cost of quarrying.

Dr. **Levison** suggested that the removal of portions of the talus would increase the apparent height of the cliffs, if blasting of the latter could be prevented. Dr. **Hovey** described the similar trap formations of Connecticut.

The Secretary announced that this section and the Biological section had been requested to nominate candidates before April 20th, for the grant of the Newberry Research Fund, the grant this year being restricted to those working in botany and geology. Authority was granted to the chairman and secretary of the section to make such nominations to the Council.

The Chairman announced the course of lectures on "The

Principles of Geology," to be delivered at Johns Hopkins University in April, under the G. H. Williams Memorial lectureship, by Professor W. C. Brögger, of Christiania; also the receipt of the program of the International Geological Congress, at which the Academy will be represented by Professor J. J. Stevenson.

The chair also announced the death of Dr. Oliver P. Hubbard, one of the earliest members of the Academy.

On motion of Professor R. E. Dodge, a committee of three was appointed to draft resolutions on the death of Dr. Hubbard, and the chair appointed Dr. Julien, Professor Stevenson and Dr. Hovey such committee.

Professor **Stevenson** presented the following minute upon the life of Dr. H. B. Geinitz, whose death was announced at the February meeting:

"Professor Hans Bruno Geinitz, for many years an Honorary Member of this Academy, died January 23, 1900, in the 86th year of his age. His work as a geologist began very early, for in 1837, when only twenty years old, he published a paper on the Muschelkalk. From that time until within a few weeks of his death, brief notices, memoirs and volumes appeared in rapid succession. There seemed to be no limit to his capacity for hard work. He studied the Cretaceous, Triassic and Carboniferous in detail, and his works on the coal fields of Saxony and Germany were marvels, when published, half a century ago. His papers on palæontology—vertebrate and invertebrate—and palæobotany, are numerous and important.

He was put in charge of the Royal Mineralogical Cabinet in 1846, and retained the position until 1898. The collections increased rapidly, so that in 1857, the Royal Cabinet became the Royal Museum, which, in later years, was one of the chief attractions for foreign visitors. In addition to his other labors he was Professor of Mineralogy in the Royal Polytechnic School of Dresden, from 1850 to 1896, serving meanwhile upon numerous government commissions.

Professor Geinitz was a typical student, caring little for things of this world, devoted to geology and his family. He was genial, sincere, a tender father, a generous friend. By his death

German science has lost one of its most conscientious workers, and Saxony one of its most respected citizens."

Dr. Alexis A. Julien and Dr. Theodore G. White were unanimously elected Chairman and Secretary, respectively, of the Section for the ensuing year.

After a vote of thanks to the lecturers of the evening, the meeting adjourned.

THEODORE G. WHITE,
Secretary.

SECTION OF ANTHROPOLOGY AND PSYCHOLOGY.

MARCH 26, 1900.

Section met at 8:15 P. M., Professor Cattell presiding.

The following program was offered:

A. L. Jones, THE SYMBOLIC CHARACTER OF GEOMETRICAL FORMS AS A PRINCIPLE OF EXPLANATION.

R. S. Woodworth, THE FATIGUE OF VOLUNTARY MOVEMENT.

E. L. Thorndike, WEBER'S LAW IN JUDGMENTS OF COMPARISON WITH A MENTAL STANDARD.

SUMMARY OF PAPERS.

Among the attempts to explain formal beauty that of Lipps in his Raumästhetik is the most striking. He maintains that the æsthetical value of beautiful geometrical forms is due to the fact that they symbolize the activity of mechanical forces working themselves out freely; that we sympathize with the forces thus represented and receive pleasure when their action is unhindered; that the forces and laws of their action are not consciously recognized but are merely *felt* or known unconsciously. His explanation involves some questionable metaphysics. The action of mechanical forces is no doubt an important element in many beautiful objects, but it remains to be proved that it is sufficient to explain all formal beauty in objects.

Dr. **Woodworth** stated that the fatigue movement may be studied in reference to the loss in force, in accuracy, or in speed. In each of these respects experiments show that a movement may be continually repeated for hundreds and even thousands of times with only a comparatively slight loss of efficiency. The ergographic curve given by Mosso for force of movement is to be abandoned absolutely as a true picture of the curve of fatigue. This fact has been of late recognized in some able articles by Treves, working in Mosso's own laboratory; but is best brought out by the use of Cattell's spring ergograph. One of the great causes of fatigue in force, and also in speed of movement is the failure of the muscles to relax completely between successive contractions. If care is taken to secure this relaxation, 1,000–1,500 maximal ergographic contractions can be made with a loss of only 10 per cent. of the initial force. From the slowness of fatigue of various modes of voluntary movement, the inference follows that the fatigue of nerve centres is not rapid, as Mosso and Lombard have supposed, but slow in progress. This view is confirmed by tests of prolonged, hard and monotonous work of a mental kind. The quick and overmastering fatigue of common experience is not so much actual inability and loss of function, as it is disinclination, resulting from disagreeable sensations and emotions, and from impulses to change.

The third paper by Dr. **Thorndike** presented the results of some experiments on the accuracy of discriminations of weight, length, and area, by subjects who judged by the aid of mental standards only. Within the limits chosen (40–12 gr., ½–12 ins., 20–60 sq. cm., and 2–12 sq. ins.), the accuracy of discrimination was found to decrease very slowly, very much more slowly than Weber's law or even the law of the combination of errors would allow. The theory proposed to account for this was that our judgments of amount or of difference are of complex origin, and may be made on various grounds. In so far as the ground is an accurate mental standard, the sensations corresponding to large amounts may be associated with the proper judgment nearly or quite as readily as small amounts. In so far as the ground is a combination of feelings or judgment, the inaccuracy of judgment may vary, because of the combination of errors, as the square root of the amount. In so far as the ground is the mere mental shock of difference, the inaccuracy of the judgments may vary in some more direct relation to the amount.

CHARLES H. JUDD,
Secretary.

BUSINESS MEETING.

APRIL 2, 1900.

Academy met at 8:23 P. M., President Woodward presiding.

The minutes of the last business meeting were read and approved.

In the absence of the Secretary of the Academy, the President requested Dr. W. S. Day to act as Secretary pro tem.

The following Candidates for resident membership, approved by the Council, were duly elected:

Charles Bergen Davis, 321 West 124 Street.
Miss Esther Byrnes, 85 Hancock Street, Brooklyn, N. Y.

WM. S. DAY,
Recording Secretary pro tem.

SECTION OF ASTRONOMY, PHYSICS AND CHEMISTRY.

APRIL 2, 1900.

Section met at 8:25 P. M., Professor W. Hallock presiding.

The minutes of the last meeting of Section were read and approved.

The following program was then offered:

William Hallock, OVERTONES OF A TUNING FORK.

William Hallock, NOTE ON SPECIFIC GRAVITY WEIGHINGS.

M. I. Pupin, A NEW FARADMETER.

C. E. Furness, CATALOGUE OF STARS WITHIN ONE DEGREE OF THE NORTH POLE AND THE OPTICAL DISTORTION OF THE HELSINGFORS ASTROPHOTOGRAPHIC TELESCOPE.

SUMMARY OF PAPERS.

Professor **Hallock** stated that the first regular overtone of a tuning fork is about two and a half octaves above the fundamental, but Lord Rayleigh pointed out that when the amplitude of the vibration became so great that the restoring force was no longer proportional to the displacement, the octave appeared, as indicated by theory. Lord Rayleigh recognized the presence of the octave with his ear and by the use of a resonator. Professor Hallock obtained direct evidence of this effect by means of a photograph of a manometric flame, the capsule of which was resting against the prong of the fork.

In a paper on "Specific Gravity Weighings," Professor **Hallock** spoke of a number of points in which the ordinary operations could be improved. It is very convenient to use the principle of the Jolly balance in which there is a pan always immersed to hold the body when weighing it in water. The effect of capillarity on the supporting wire which at best lessens the sensibility of the balance, can be avoided by sending a series of little waves across the surface of the water while weighing. To get rid of bubbles in little corners of irregular bodies, these bodies may be held under the tap at the sink and moistened with water before immersion or, still better, they may be moistened with alcohol and then with water before immersion.

Professor **M. I. Pupin** described a new faradmeter, which he had devised, an instrument for measuring the capacity of a condenser. This instrument is essentially a Wheatstone's bridge, using alternating currents, in which one leg of the bridge consists of two resistances in series and the other leg consists of two capacities in series, one of the two being that of a standard condenser, the other being the unknown capacity to be measured. In the bridge connecting the two points, one between the two resistances, the other between the two capacities, is a telephone. If the two separate circuits, each containing one of the two capacities, are arranged so that the capacity reactance is by far the greatest part of the impedance in that circuit, then silence in the telephone will be obtained when the two resistances are to each other inversely as the two corresponding capacities. The apparatus has been employed in the Columbia University laboratory and gave complete satisfaction. It is capable of a tolerably high degree of accuracy, but its principal merit is its convenience.

Professor **J. K. Rees** presented a paper by Miss C. E. Furness on "A Catalogue of Stars Within One Degree of the North Pole and the Optical Distortion of the Helsingfors Astrophotographic Telescope." The paper gave the results of measurements on 65 stars. By using stars near the Pole, the same group of stars can be taken at different angles with reference to the object glass of the telescope. At Helsingfors the Pole is sufficiently far from the horizon to avoid trouble with refraction. From the measurements, the distortion of the Helsingfors lens was found to be not appreciable.

WM. S. DAY,
Secretary.

SECTION OF BIOLOGY.

APRIL 9, 1900.

Section met at 8:15 P. M., Professor F. S. Lee presiding.

The minutes of the last meeting of Section were read and approved.

The following program was then offered :

M. A. Bigelow, EMBRYOLOGY OF LEPAS.

F. E. Lloyd, THE GENUS LYCOPODIUM IN NORTH AMERICA.

SUMMARY OF PAPERS.

Mr. **Bigelow's** paper was based upon the results of an investigation recently completed, which was undertaken with the view to applying the cell-lineage method in an accurate study of the cleavage and the formation of the germlayers in *Lepas* and other Cirripedes.

Four species have been studied, but the only complete series of embryonic stages was obtained from *Lepas anatifera.*

The cleavage of *Lepas* is totally unequal and regular. Stages of 2, 4, 8, 16, 32, and 64 cells are normally formed. Cells of a given generation may anticipate their fellows in division, but no second division of such cells takes place before all other cells have completed corresponding cleavages and become of the same generation.

The first cleavage is nearly parallel to the long axis of the ellipsoidal egg. The egg is divided into an anterior ectoblastic cell and a posterior yolk-bearing macromere. The second cleavage is at right angles to the first, both cells dividing, and from the yolk-macromere is cut off a second ectoblastic cell. The third cleavage is essentially perpendicular to the first two, dividing all of the cells, and a third ectoblastic cell is separated from the yolk-macromere, which is now mesentoblastic. Thus by the first, second and third cleavages three cells are separated from the yolk. These three cells contain all the ectoblast, and by repeated division they form the blastoderm. The fourth cleavage separates the mesoblast from the ectoblast, which is now represented by the yolk-macromere.

The 16-cell stage is composed of fourteen ectoblastic cells which largely surround the entoblastic yolk-cell. The single mesoblast cell lies in the blastoderm at the posterior edge of the blastopore, where the entoblastic yolk-cell is still exposed to the exterior. By the fifth cleavage all these cells are divided, the two mesoblastic cells still remaining on the surface. During the sixth cleavage the two mesoblastic cells sink beneath the blastoderm as it closes over the blastopore. At the same time four cells of the blastoderm, lying at the anterior and lateral edges of the blastopore, divide perpendicularly to the surface. Four cells are thus formed, beneath the blastoderm, and they are apparently added to the mesoblast. The entire mesoblast then originates from one cell which is separated from the entoblast in the fourth cleavage 16-cell stage, and from four other cells which are derived from the ectoblast in the sixth cleavage forming the 62-cell stage.

The course of the cleavage as sketched above has been determined to be quite constant. Cells of definite origin in the early cleavage stages, are the ancestors of cells which occupy particular positions in later stages. Following Conklin's terminology ('97) the cleavage may be characterized as "determinate." This conclusion is completely opposed to the results of the earlier investigators of cirripede development.

Gastrulation is of the epibolic type, and is the result of the extension of the ectoblastic blastoderm over the entoblastic yolk-macromere. The blastodern usually closes over the blastopore during the sixth cleavage (62 cells). The blastopore is identified as marking the ventral and posterior of the future embryo.

In the general features of the late development of the embryo the results of this investigation confirm those of some earlier workers.

On account of the discomfort caused by the low temperature of the room the second paper of the evening was omitted by general consent.

On motion of Professor F. E. Lloyd, a committee of one was appointed to communicate with the Recording Secretary in regard to the unsatisfactory heating arrangements, with a request that a complaint be lodged against the culpable parties.

Mr. Lloyd was asked to serve as the committee.

Adjournment followed.

Francis E. Lloyd,
Secretary.

GEOLOGY AND MINERALOGY.

April 16, 1900.

Section met at 8:20 P. M., Dr. A. A. Julien presiding.

The minutes of the last meeting of Section were read and approved.

The following program was then offered:

R. Ellsworth Call, Some Preliminary Notes on Crystal Growths in Mammoth Cave. (Illustrated by Lantern Slides.)

E. O. Hovey, Scenery of the Harney Peak District in the Black Hills, S. D. (Illustrated by Lantern Slides.)

E. O. Hovey, Biographical Notice of Professor Oliver P. Hubbard.

Summary of Papers.

Dr. **Call's** mineralogical notes were preceded by a brief resumé of the geology of the vicinity of Mammoth Cave. The strata making the geologic section are nearly horizontal, and all the rocks forming the cavern are of sub-carboniferous age. The region of the cavern is capped with sandstones of the Chester Group, 500 feet thick. Under these are oolitic and other limestones, in which the cavern is excavated to a thickness of over 350 feet. The drainage level of the cavern is determined by the present level of Green River. Five different levels have existed during geologic time. No gypsiferous strata are known in the region. The overlying sandstone is usually quite ferruginous ; but no pyrite occurs in either strata. Secondary crystallization has occurred in many of the stalactites, causing them to simulate the fibrous appearance sometimes assumed by aragonite. The stalactites of recent origin almost all have a downward-projecting tree root as their origin of fixation, or are beneath sink-holes. The chief objects of mineralogical interest are the gypsum crystals, which cover the sides and ceilings of certain avenues in the cavern, in the upper of the five levels only, and not in any levels now occupied by streams. These crystals are sometimes curiously and remarkably contorted, and the terminations of the crystal masses are often recurved in a direction contrary to the direction of gravitation. Occasionally the gypsum assumes a botryoidal form, but is commonly found as needles or aggregated in loose masses of fibrous crystals. The gypsum crystals occur only along cracks, and are built up by increase from the base, while the calcium-carbonate stalactites are always built up by additions to their surface or terminations. It is difficult to account for the large amount of sulphur needed by assuming its origin in organic bodies, such as plants and the forests which are of abundant growth in the region, and have been abundant for geological ages. The origin of the carbon dioxide necessary for the great work of solution which has been accomplished is likewise found in the decaying vegetation. The origin of the sulphuric acid required to produce these enormous quantities of gypsum crystals, which have fallen so abundantly as to fill up certain avenues, is still problematic. Only one other mineral is found—flocculent crystals of magnesium sulphate, pendant from the ceiling of two or three small rooms. There are no calcite or quartz crystals.

The paper was illustrated by lantern slides, showing the peculiarities of the stalactite and gypsum formations.

Professor **Kemp** in discussion, suggested that the small percentage of sulphur present in the limestones themselves might, after solution of the latter, aggregate sufficient sulphur to afford gypsum along the crevices. Dr. **Julien** and Professor **Stevenson** each cited cases in the Caribbean and Bermuda Islands where the amount of vegetation now or formerly growing on the surface was insufficient to accomplish the solution required for the great caves which exist in the coral limestones, both of Tertiary and recent growth in the islands.

Dr. **Hovey's** paper was read by Professor Kemp, owing to the former's unavoidable absence. After a brief resumé of the geology of the Black Hills District, a series of views was shown illustrative of the extraordinary erosion forms of the schists and pegmatites of the Harney Peak District. His views also showed the tin mines of the Black Hills, in which spodumene crystals of large size have recently been obtained as a valuable source of Lithium, as a commercial product. One spodumene crystal here obtained was thirty feet long. The granite veins have also been described by Van Hise.

Discussion followed concerning the occurrence of extraordinarily large crystals of other minerals.

The biographical notice of Professor Oliver P. Hubbard, prepared by Dr. Hovey, was read by the Secretary, and will be published with an accompanying list of Dr. Hubbard's publications, in the *American Geologist*.

Professor **Stevenson**, in behalf of the committee appointed to prepare a minute respecting the late Professor Hubbard, offered the following:

"**Oliver Payson Hubbard** was born in Pomfret, Conn., March 31, 1809, and died in New York, March 9, 1900. After graduating at Yale College in 1828, he remained in that institution as assistant to Professor Silliman until he began his study of medicine, which he completed in 1837, when he received the degree of M.D. from the South Carolina Medical College at Charleston.

"Prior to his graduation in medicine, he was made Professor of Chemistry, Pharmacy, Geology, and Mineralogy in Dartmouth College. In 1871, the Chair was restricted to Chemistry and Pharmacy, and no longer required his full time, so that he was able soon afterwards to make New York his home during much of the year. In 1883, he felt that he has already passed the age when one should retire from a professorship, and resigned his position, becoming professor emeritus. Thereafter he remained in New York.

"His youthful love of science led him to Yale that he might study under Professor Silliman, then the prominent teacher of science in our country. His first publication, entitled 'Geological and Mineralogical Notices,' having reference to localities in Northern New York, appeared in the *American Journal of Science* in 1837, and was followed in 1838 by a somewhat more elaborate article upon the White Mountains. He attended the 1841 meeting of the Association of American Geologists and Naturalists and read a paper of capital importance upon the slates of Waterville, Maine, in which he discussed the markings upon the slates, and indicated their organic origin, which he regarded as proving their great age. He was present also at the third meeting, and took a prominent part in the discussion of the 'drift,' so that he was appointed member of the committee to prepare a report upon that subject for the next meeting. He was elected Secretary of the Association for 1833, and, with Benjamin Silliman, Jr., served in the same office for 1844. His duties at Dartmouth were exacting, so that for many years he published few extended papers; but he made many brief communications to societies, all of which were characterized by keen discrimination, and many of them were important contributions.

" Dr. Hubbard joined this Academy in 1874, and at once became so active that when Mr. Browne, who had been Recording Secretary from 1839, resigned in 1875, Professor Hubbard was chosen as his successor. He retained this office until 1885, when he became Vice-President. At the death of Dr. Newberry in 1892, he was made President ; but he served for only one term, declining reëlection because of his advanced years. From 1874 until 1893 he rarely failed to attend the meetings, when in the city, and he always presented something of interest bearing upon matters under consideration. His manner was courteous to the last degree, and he understood well how to discuss without disputing.

" Professor Hubbard's individuality was very decided ; though so gentle and considerate in his manner, he always held positive opinions, and, when necessary, did not hesitate to express them. His shrewd common sense made him a good counsel, and his advice was sought in many directions. He was a member of the New Hampshire legislature in 1863–4 ; but one year's experience in that kind of work sufficed, and he declined to be a candidate for reëlection. His quiet humor and his store of reminiscences made him a delightful companion. He retained his mental vigor to the last, and only two months ago he published an article correcting errors in a recently published work. When ninety years old, he attended the New York meeting of The Geological Society of America, and remained throughout an afternoon listening to severely abstract papers, with as much interest apparently, as though he were just beginning his work.

" Professor Hubbard was almost the last link binding our time with that of the early geologists. Hall and Dana died within the last half decade, and there remain only Boye and Lesley of those who attended the earlier meetings of the Association of American Geologists. He passed away in a ripe old age, his life full of good works, and his name absolutely unstained. This Academy owes him much, and here his name should be cherished.

"(Signed),
"J. J. Stevenson,
"Alexis A. Julien."

Theodore G. White,
Secretary.

SECTION OF ANTHROPOLOGY AND PYSCHOLOGY.

April 23, 1900.

Section met at 8:15 P. M., Prof. J. McK. Cattell presiding.

The minutes of the last meeting of Section were read and approved.

The following program was then offered:

Dr. **Livingston Farrand,** Recent Researches in Central Australia.

Dr. **Franz Boas,** The Eskimo of Cumberland Sound.

Summary of Papers.

Dr. **Farrand's** paper called attention to certain points of particular significance in Messrs. Spencer and Gillen's book, "The Native Tribes of Central Australia," which appeared last year. Special emphasis was laid on the suggested origin of the religious side of totemism as indicated in the "Intichiuma" ceremonies of the Arunta tribe, which are directed apparently solely towards the end of increasing the supply of the totem animals and plants of the district, each totem group being charged with the treatment of its own totem object and its multiplication for the benefit of the other members of the tribe. The well-known prohibition against killing and eating the totem seems to hold in this region, but tradition and ceremony point to a time when this was not the case. This economic explanation of the custom is the first satisfactory one yet offered and is plausible for the tribes under discussion even though it may not hold for other parts of the world. The social aspect of totemism with its marriage regulations still remains a problem.

The material on which Professor **Boas'** paper was based was collected by Captain James Mutch. A full version was given of the myth of the creation of land and sea animals, and a description of the beliefs of the people in regard to souls and in regard to a series of heaven and underground worlds which are the abodes of the deceased. A number of taboos were described, and their explanation as given by the Eskimos was stated. They believe that the transgression of a taboo prescribed after the death of an animal causes the transgression to become fastened to the soul of the animal, which goes down to the mistress of the lower world, where the transgressions make the hands of the deity sore. This enrages her, and she causes famine and misfortunes of all kinds.

CHARLES H. JUDD,
Secretary.

PUBLIC LECTURE.

APRIL 30, 1900.

Under auspices of Section of Astronomy, Physics and Chemistry.

Professor **William Hallock,** THE NATURE OF THE ATOM AS INDICATED BY RECENT SPECTRUM ANALYSIS.

This is the age of effects. Formerly people were discovering laws. The Zeeman effect is the one which has given most information recently on the subject of the nature of the atom. Chemical investigations brought us to the atomic theory. The complex nature of the atoms was shown by the spectrum analysis of Bunsen and Kirchhoff. They showed that in its number of modes of vibration, the atom was more complicated than a musical instrument. Faraday discovered the rotation of the plane of polarization of light by the magnetic field. He tried and failed to get any effect of the magnetic field on the source of light itself, the vibrating atom. Zeeman finally succeeded a few years ago in obtaining this effect called after his name. It shows itself as a splitting up of the lines of the spectrum into double, triple and more complex lines, when the source of light is placed in a strong magnetic field. The Zeeman effect, together with J. J. Thomson's experiments and speculations, give us the idea of the atom being composed, in part at least, of corpuscles, one of which, being detached, forms the negative ion of the cathode rays and other phenomena, while the part left behind, having a much greater mass, forms the positive ion. In these corpuscles we may have the primeval material from which all other matter is composed.

The lecturer showed a number of lantern slides of photographs of the Zeeman effect and of the various kinds of apparatus by which it is investigated.

Wm. S. Day,
Secretary.

BUSINESS MEETING.

May 7, 1900.

Academy met at 8:15 P. M., Professor William Hallock presiding.

The minutes of the last business meeting were read and approved.

The Secretary reported from the Council as follows:

The appointment of Dr. Theodore G. White as Acting Editor.

The establishment of a series of rules for publication.

The vote of the Council to secure photographs of past presidents of the Academy, to be hung in the Library.

The vote of the Council to extend their thanks to Professor Kemp for his valuable services as Chairman of the Exhibition.

The vote of the Council to send the thanks of the Academy to President Morris K. Jesup for his courtesy and kindness in allowing us to use the Museum for the Annual Exhibition, and through President Jesup to the employees of the Museum, for their cordial assistance and good will.

The Secretary also announced that Professor Henry F. Osborn had been made a Life Member of the Academy.

The following candidates for resident membership, approved by the Council, were duly elected:

W. J. Gies, Ph.D., 437 West 59th Street.
Charles Henry Davis, 99 Cedar Street.

RICHARD E. DODGE,
Recording Secretary.

SECTION OF ASTRONOMY, PHYSICS AND CHEMISTRY.

MAY 7, 1900.

Section met at 8:30 P. M., Prof. Wm. Hallock presiding.

The minutes of the last meeting of Section were read and approved.

The following program was then offered.

Bergen Davis, THE BERNOUILLI EFFECT IN STATIONARY SOUND WAVES.

R. W. Wood, COLOR PHOTOGRAPHS AND SOUND WAVE PHOTOGRAPHS, EXHIBITED BY PROFESSOR HALLOCK.

SUMMARY OF PAPERS.

The experiments described by Mr. **Davis** were in three groups, those with a sound wave anemometer, those with the use of empty gelatine medicine capsules instead of cork dust to show the Kundt figures, and those concerning the longitudinal motion of a cylinder closed at one end, across the stream lines in a stationary sound wave.

The stationary sound wave was that produced by a stopped organ pipe, provided with a glass panel for observation, when it was sounding its first overtone. A thin rubber diaphragm near the central node prevented air currents due to the blowing of the pipe. The cups of the miniature anemometer were made by dividing No. 2 gelatine capsules longitudinally so as to form half cylinders and mounting them on card-board arms, the anemometer rotated with ten revolutions per second in the loop of the wave and came nearly to rest in the node. The rate of revolution at various positions along the wave varied approximately according to a sine curve. The maximum amplitude of the wave as calculated from the above rate was 0.57 cm.

The Kundt's figure experiment was performed by emptying a box of No. 5 gelatine capsules into the middle of the loop. They arranged themselves in rows across the pipe. Each capsule attracted its neighbor at the ends and repelled it at the sides. The experiment is quite striking.

The motion of a cylinder perpendicularly to the stream lines was obtained by using a capsule from which the cap had been removed. Such a capsule moved in the direction of the closed end with considerable force. This was also shown by making a small mill with a capsule at the end of each of four card-board arms. The rates of revolution in various parts of the wave made, when plotted, nearly a sine curve. The force acting normally to the closed ends of the cylinders was measured with a torsion balance. The square roots of the torsion deflection gave when plotted an approximate sine curve. The experiment was performed in air, illuminating gas, carbon dioxide, and hydrogen. The torsion deflections were directly proportioned to the densities of the gases. Prof. William Hallock first suggested the cause of this effect, showing that it was due to the principle of Bernouilli, that a gas in action is less dense than the same gas at rest. The vibrating air has considerable velocity while the air within the cylinders is nearly at rest. The force is due to the difference of density on the two sides of the closed end of the cylinder. The author used this principle to determine the amplitude of vibration. Prof. R. S. Woodward assisted him in applying the proper hydrodynamical principles, and he calculated that the change in density was such as to give a pressure of 21 dynes per square centimeter, while the amplitude was 0.33 cm. This agrees closely with the value obtained with the sound wave anemometer.

Professor **Hallock** exhibited some color photographs and some sound wave photographs taken by Prof. R. W. Wood, of the University of Wisconsin.

WM. S. DAY,
Secretary.

SECTION OF BIOLOGY.

MAY 14, 1900.

Section met at 8:20 P. M., Professor F. S. Lee presiding.

The minutes of the last meeting of the Section were read and approved.

The name of one candidate for resident membership was read and referred to the Council according to the By-Laws.

The following program was then offered :

J. E. Kirkwood and **W. J. Gies**, SOME CHEMICAL NOTES ON THE COMPOSITION OF THE COCOANUT.

Frederic S. Lee and **C. C. Harrold**, THE SIGNIFICANCE OF CARBOHYDRATES IN MUSCLE.

SUMMARY OF PAPERS.

The authors of the first paper have carried on qualitative work on the ungerminated nut, preparatory to a study of the digestive processes during germination. The chief constituents are cellulose and fat. Some soluble carbohydrate is present, besides globulin and proteose, but no albumin or pepton. Only amylolytic ferments have so far been found. The milk of the nut is normally acid, probably due to acid phosphate. It contains an earthy phosphate, reduces Fehling's solution, sours on standing, and acquires much the odor and physical appearance of soured cow's milk. It shows only small quantities of proteid and fat.

The meat of the average nut contains from two to three grains of globulin, which may be obtained in crystalline form. The authors have made three preparations by the usual methods. The nitrogen averages for these were 17.91%, 17.81%, 17.68%. The ash for the same, 0.13%, 0.41%, 1.05%.

From the meat of twelve nuts it was possible to separate a little more than three grains of proteose by the usual method. The average of three closely agreeing determinations of nitrogen was 18.57%; of the ash it was 1.71%.

The quantitative relationships of these and other constituents will be subjects of combined investigation.

Dr. **Curtis** drew attention to the irritation of the mucous membrane of the bladder and urethra caused by drinking too freely of cocoanut milk. Dr. **Gies** in answer to a question stated that the food content of the cocoanut is small.

The second paper was a continuation of the senior author's study of the nature and causes of muscle fatigue. Of the two supposed causes of fatigue, loss of substance necessary to contraction and poisoning by so-called fatigue products, the present work deals with the former. It is well known that the drug phlorhizin causes the removal of the carbohydrates from an organism to which it is administered. The authors find that it induces decided evidences of fatigue in the muscles of fasting cats. A well phlorhizinized muscle is comparable to a normal muscle in the late stages of fatigue. This effect seems to be due not to a specific action of the drug on the protoplasm of the muscle cells, but to the loss of carbohydrate from the muscle. This conclusion is rendered probable by the fact that when an animal has been put well under the influence of phlorhizin, the administration of sugar (dextrose) counteracts the effect of the drug, removes the evidences of fatigue and restores the muscle. It seems probable that the loss of carbohydrate is an important factor in the early stages of muscle fatigue.

Incidentally some observations on rigor mortis have been made. A muscle well under the influence of phlorhizin may begin to go into rigor five minutes after death and rigor is complete very early. This confirms the conclusions of others that there is a close connection between rigor and carbohydrate. A muscle irrigated with dextrose is capable of giving fully as many contractions as, or even more than a normal muscle without dextrose.

The election of sectional officers resulted in the election of

Prof. C. L. Bristol, of New York University, as Chairman, and Prof. F. E. Lloyd, of Teachers College, as Secretary for the ensuing year.

Francis E. Lloyd,
Secretary.

SECTION OF GEOLOGY AND MINERALOGY.

May 21, 1900.

Section met at 8:15 P. M., Dr. Alexis A. Julien presiding.

The minutes of the last meeting of Section were read and approved.

The following program was offered:

George I. Finlay, A New Occurrence of Nephaline-Syenite and Associated Dikes in the State of Tamaulipas, Mexico, with a Review of the Distribution of these Rocks in North America.

Benjamin F. Hill, A Contribution to the Geology of a Part of Sonora, Mexico.

Summary of Papers.

The rocks described by Mr. **Finlay** were sent by Mr. E. D. Self to Professor Kemp of Columbia University. The nephaline-syenite is a very light colored rock, containing, besides abundant nephaline and anorthoclase, small patches of the dark colored silicates. Under the microscope these are seen to be ægerine-augite intergrown with hornblende, and accompanied by magnetite and apatite. Titanite is abundant, with the faces (1–2–3) well developed and some zircon occurs. The tinguaite associated with this syenite is a holocrystalline porphyritic dike rock with large phenocrysts of orthoclase, twinned on the Carlsbad law, tabular in habit, parallel to the clinopinicoid. The ground mass, which gives the rock an even, dark green color, consists of a felt of tiny blades of ægerine and orthoclase. The ægerines are at times grouped together in bundles around small patches of biotite.

Mr. Finlay then briefly discussed the distribution of similar rocks in the various portions of the United States, and exhibited a very instructive series of comparative charts of the chemical composition of the rocks examined and those of allied groups, the charts being constructed on the principles of the graphic method devised by Professor Hobbs, as worked out by Mr. Finlay.

The second paper, that of Mr. **Hill**, also treated of Mexican rocks, and the same geographical maps were employed to illustrate both papers. Little has been written about the coal bearing rocks and their associated eruptives in the State of Sonora, Mexico. The work done by Professor Dumble and his associates has thrown considerable light on some of the problems.

In the district investigated are representatives of nearly all the formations from the Archæan granites to the Quarternary sands and gravels. The most important division, however, is the Triassic. The slates, sandstones, quartzites, etc., with coal seams, make up the lower or Bananca division of the Triassic, while an immense series of associated eruptives, including andesites, dacites, tuffs, andesitic conglomerates, etc., is considered the upper division. To the series of eruptives the name of Lista Blanca has been given. The Lista Blanca has hitherto been considered post-Cretaceous.

In addition to the pre-Cretaceous eruptives, there are numerous intrusives and flows of diorites, rhyolite and basalt, and in one instance, trachite. It is probable that these are mostly of Tertiary age. The diorites exert a very noticeable effect on the formation of the ore bodies of the region.

Specimens of all the eruptives were brought to New York and studied by Mr. Hill in thin section under the microscope. A series of chemical analyses of the type rocks was made and a very clear relation established between the magmas of the different flows. The remainder of the paper dealt with details of the petrographic characteristics of the rocks.

Both papers were discussed by Professor Stevenson, Professor Kemp, Dr. Julien, and Dr. White.

Theodore G. White,
Secretary.

SECTION OF ANTHROPOLOGY AND PSYCHOLOGY.

May 28, 1900.

Section met at 8:30 P. M., Prof. J. McK. Cattell presiding.

The minutes of the last meeting of Section were read and approved.

The following program was then offered:

Dr. **G. B. Germann,** The Acquirement of Motor Habits.

Dr. **C. H. Judd,** Studies in Vocal Expression.

Summary of Papers.

The first paper reported some experiments in which the author measured the degree of perfection attained in rapid naming of one hundred color squares arranged in regular order, by the time required to read the whole series. Results were presented for the rapidity of reading at different stages of practice and after different intervals of discontinuance of practice.

The second paper reported changes in pitch during the articulation of single words. The pitch was determined by means of enlarged records of diaphragm vibrations which were compared with the tracings made by a standard tuning fork. Twenty records were reported. In general the accented syllable was higher in pitch than the unaccented syllables, though this was not true in such words as abhorrent and abnormal. The final syllable in the twenty records showed a very general tendency to fall off in pitch. The amount of change in such words as educing and illusion will appear from some cases of the former. The three syllables were as follows, case I, 161, 244, 171 (end of the syllable being at 131); case II, 157, 265, 185 (end of syllable 125); case III, 172, 248, 166 (end of syllable 123). Other records did not show such marked changes. One of the word abasement is as follows: 103, 130, 140.

Chas. H. Judd,
Secretary.

BUSINESS MEETING.

October 1, 1900.

Academy met at 8:15 P. M., President Woodward presiding.

The minutes of the last business meeting were read and approved.

The Secretary reported from the Council as follows:

The resignation of Mr. Gilbert van Ingen as Editor, and the extension on the part of the Council of a cordial vote of thanks to Mr. van Ingen for his successful services as Editor.

The adoption of a time limit for all papers presented before the Academy, said time limit to be printed on the announcements in each case.

The following Candidate for resident membership, approved by the Council, was duly elected:

Richard H. Cunningham, M.D., 200 West 56th Street.

Richard E. Dodge,
Recording Secretary.

SECTION OF ASTRONOMY, PHYSICS, AND CHEMISTRY.

October 1, 1900.

Section met at 8:35 P. M., Prof. Wm. Hallock presiding.

The minutes of the last meeting of Section were read and approved.

The following program was then offered:

E. R. von Nardroff, On the Application of Fizeau's Method to the Determination of the Velocity of Sound. (Illustrated.)

J. K. Rees, Scientific Instruments at the Paris Exposition. (Informal report.)

W. Hallock, A Peculiar Lightning Discharge.

Summary of Papers.

Professor **von Nardroff** used as a source of sound a very shrill whistle giving sound of a short wave length beyond the limits of hearing. He overcame the effect of irregular disturbing reflected and diffracted waves by using sound of considerable intensity and a flame only slightly sensitive. The sound after passing between the teeth of a rapidly revolving wheel, fell on a concave spherical mirror made of wood some distance away, and was reflected back through the teeth at the opposite end of a diameter of the wheel, and came to a focus on a sensitive flame just behind the wheel. The author gave a neat demonstration of the working of the apparatus and showed with great ease how with increasing speed of the revolving wheel the flame was alternately shielded from and exposed to the sound. The slightest disturbance of the adjustment of the mirror threw the flame away from the mirror in a marked manner. He stated that the method could probably not be used to compete with other accurate methods heretofore employed, but it supplied a beautiful illustration of Fizeau's method of measuring the velocity of light.

Prof. **J. K. Rees** gave an interesting account of some of the scientific instruments at the Paris Exposition. The great telescope was not finished, although this fact was not yet generally known, and it was impossible to tell yet whether it was to be a success or not. The German exhibit was superb. The Germans had a method, which ought to have been generally adopted, of arranging the instruments with one kind by the different makers in one case, instead of a complete line by each maker in a case by itself. An ingenious modification of Foucault's pendulum was seen at the Paris observatory. It was only one meter long, but it showed the fact of the rotation of the earth after the lapse of fifteen seconds.

Professor **Hallock** described a peculiar lightning discharge he had observed at Lake Champlain. The flash came unexpectedly from a cloud about two miles from where the main shower was falling. It struck on a mass of rock, and on examining this it was found that instead of there being one or a few places where the lightning had struck, it was covered with innumerable little spots, each one indicating where a part of the flash had struck.

WM. S. DAY,
Secretary.

SECTION OF BIOLOGY.

OCTOBER 8, 1900.

Section met at 8:15 P. M., Prof. C. L. Bristol presiding.

The minutes of the last meeting of Section were read and approved.

The evening was devoted to REPORTS OF SUMMER WORK BY MEMBERS OF SECTION.

SUMMARY OF PAPERS.

Prof. **E. B. Wilson** reported that he spent the summer at Beaufort, N. C., where he prosecuted experimental researches upon the eggs of Toxopneustes. Loco's experiments upon the eggs of arbacia were confirmed, and further facts of great interest were determined. Later in the season Professor Wilson visited Woods Holl, Mass., Mt. Desert, Me., and the Bay of Fundy. He drew attention to the very great difference between the Beaufort and Bay of Fundy faunas. The transparent pelagic annelid was collected in the latter locality.

Dr. **D. T. MacDougal** spent the summer in studying the flora of Priest Lake, which stands at an elevation of 3,000 feet in northern Idaho. He was especially concerned in studying the effect of air temperatures on the distribution of plants.

Prof. **H. F. Osborn** visited the British Museum and the Museum of Comparative Anatomy in the Jardin des Plantes, Paris. The latter has, under the hand of Dr. Filhol, reached a high degree of effectiveness. At the British Museum Professor Osborn examined the remains of the new Patagonian sloth Neomylodon, a form said by Ameghino to be still extant, though by some claimed to be extinct.

Mr. **F. B. Sumner** gave an account of experiments carried on at the Marine Laboratory at Naples. The work of Mr. Sumner was directed towards determining the validity of his confluence theory of the origin of the embryo in fishes. The results are regarded as confirmatory.

The work in the Bermuda Islands carried on in previous summers by the expeditions from the New York University under the direction of Professor Bristol was continued this summer. Mr. **F. C. Waite** was this year a member of the party, and reported the finding of much valuable and interesting material not heretofore collected.

Dr. **M. A. Howe** also worked in the Bermudas during the first half of the summer, going later to Edgartown, Marthas Vineyard, and to Sequin Island, Maine. He was especially concerned with the collection of marine algæ. Dr. Howe reported the collection of a large number of algæ, and described the general floral features of the islands.

Dr. **H. E. Crampton** stated that the summer session at Woods Holl had been a successful one.

Mr. **M. A. Bigelow,** while at Woods Holl, confirmed his results on *Lepas* and added a number of new observations. He, with Dr. Crampton, carried on a study of the ponds along the southern shore of Marthas Vineyard, with a view to studying the variation in their fauna.

Prof. **F. E. Lloyd** spent six weeks in company with Prof. S. M. Tracy in a preliminary study of the flora of the Mississippi sound, islands, and delta. A full series of plants was collected. Professor Lloyd described the leading features of the vegetation of that region.

Francis E. Lloyd,
Secretary.

SECTION OF GEOLOGY AND MINERALOGY.

October 15, 1900.

Section met at 8:15 P. M., Dr. A. A. Julien presiding.

The minutes of the last meeting of Section were read and approved.

The names of two candidates for resident membership were read and referred to the Council according to the By-Laws.

The following program was then offered:

Gilbert van Ingen, Paleozoic Faunas of Northwestern New Jersey.

Theodore G. White, THE GLENS FALLS, N. Y. SECTION OF THE LOWER ORDOVICIAN.

Henry S. Washington, THE ROCKS OF LAKE WINNEPESAUKEE, N. H.

Daniel S. Martin, MINERALS FOUND AT HADDAM, MAINE.

Alexis A. Julien, THE GEOLOGY OF CENTRAL CAPE COD.

Richard E. Dodge, PHYSIOGRAPHY OF THE REGION OF THE COLORADO CAÑON.

Also notes by **J. J. Stevenson** and **E. O. Hovey**.

SUMMARY OF PAPERS.

Mr. **van Ingen** described the work of the party belonging to the Geological Survey of New Jersey, which, during the past two summers has been engaged in tracing the outcrops of the Paleozoic formations, and collecting fossils. Of this party, Mr. Kümmel, the assistant State geologist, traces the boundaries and works out the tectonics, while Dr. Weller, of the University of Chicago, collects fossils at localities indicated by Mr. Kümmel. During July, Mr. van Ingen spent a week with this party in the field at Newton. Newton is situated on the shales of the Trenton Group, there extensively quarried for slates. To the east is a low ridge of limestone which presents the same appearance as the Barnegat limestone along the Hudson river.

The upper part of this limestone has yielded trilobites, probably *Dikellocephalus*, indicating that this portion is of upper Cambrian age. At other localities a trilobite described by Weller as *Liostracus Jerseyensis*, shows that the rock there is also Cambrian, probably of the middle or upper division. In the vicinity of Franklin Furnace good specimens of *Olenellus cf. thompsoni* were found at localities described by Foerste. Further to the east of Newton, on the other side of the Cambrian ridge, is a wide belt of Ordovician rocks, Trenton limestone overlaid by a thick series of shales. The limestone contains the typical Trenton fauna, *Rafinesquina*, *Plectambonites*, *Pterygometopus*, etc., and is very like that found at Rosetown, Ulster county, and at Rochdale, Dutchess county, N. Y. The shale has few fossiliferous beds, but occasionally one of the more sandy layers contains *Dal-*

manella testudinaria, *Plectambonites* and *Rafinesquina*, the same combination found in the Hudson shales at Poughkeepsie and at Rondout. At one locality was found a fauna with *Ampyx* and *Harpes*. In eastern New York these genera of trilobites are found only in the Chazy limestone, and the discovery is of great interest in that it indicates the presence of this formation at a distance of almost 250 miles south of what has hitherto been recognized as its southern limit. Further to the northwest, along the Delaware river, were found the Silurian and lower Devonian formations. The finest section is seen in the face of the cliff of the old Nearpass quarry, about five miles south of Tri-States, where all the formations from the upper Ordovician to the Esopus shale of the lower Devonian appear, with numerous fossils. At Otisville the Shawangunk grit is finely exposed in a large quarry. All the evidence at hand points to the conclusion that this formation, of a thickness of at least a thousand feet, was formed as a flood plain deposit. Its characteristics, except color, are the same as the New Jersey and Connecticut valley Triassic sandstones. Ripple-marks, sun-cracks, cross-bedding, channel-fillings, etc., are abundant. In the railroad cut west of Otisville the grit lies upon the Hudson shales, with coincident dip. On the contact there occurs a few inches of clay, which next the shale is quite free of pebbles, while next the grit it is filled with quartz pebbles. This was interpreted to be residual clay caused by the decomposition of the shale, through subaërial agencies, before it became covered by the grit. The old notions regarding rock-formation required the presence of a body of water in which the sediments might be deposited. Several of the geological subdivisions showed characters which would not have been present had these formations been laid down under water, for this mode of origin results in a sorting of the rock-forming materials, and no sorting is detected in these grits. Flood plain deposits are very irregular, both as to stratification and sorting of materials, and these features are well exhibited in the grits. Other formations that are probably flood-plain deposits are parts of the Potsdam sandstone in eastern New York, the Medina sandstone, the sandstones of the Catskill group, and many of the sandstones of the coal measures of Pennsylvania and the Mississippi valley, in fact the greater part of the "barren Measures."

Dr. **White** described his recent detailed study of the faunas of sucessive strata at Glens Falls, and their relations to similar studies along the lake Champlain valley to the north, and the Mohawk and Black River valleys to the west. The section forms a low anticline along the shore of the Hudson. At the base is seen the Calciferous sandrock, containing *Ophileta* and fucoids. Conformable upon this is a layer a few inches thick, of barren black shale, which is very much crushed, and then the same beds of the *ostracod-Liperditia*, and their associated corals and peculiar forms of *Strophomena*, as have been found in the lowest Black River zones on Button Island in Lake Champlain. The zones of *Parastrophia* and *Triplesia* occurring near this portion of the series in localities to the north and west, were not found here. The succeeding coral beds of *Columnaria* were well developed. Above these are the cross bedded gray beds, which in some recent reports have been considered to represent the Birdseye limestone, which seems to be lacking in this locality, unless met with at this unexpectedly high position. The upper portion of the section, which is of lower Trenton age, shows no unusual forms. The tendency of the lowest and uppermost portions of the Ordovician sections in the region to wear away and appear wanting, owing to their prevailing softness, was commented on.

The remarks of Dr. **Washington** were in the nature of a preliminary report on work done by Professor Pirsson and himself on Mount Belknap and Red Hill, near Lake Winnepesaukee, N. H. The rocks of Mount Belknap are shown to be prominently a quite uniform alkali syenite, which is cut by many dikes of camptonite and allied rocks, and of bostonites, aptites, and syenite porphyries. These dikes also cut the surrounding porphyritic gneiss. At one place, near the border, is a mass of basic hornblende-gabbro, with large, poikilitic phenochrysts of brown hornblende. A syenite breccia also occurs. At Red Hill similar syenite, formerly described by W. S. Bayley, occurs on the summit, while toward the periphery, nepheline appears as a constituent, and a true foyaite is developed. The mass is also cut by dikes, both camptonitic and syenitic. The region is to form the subject of a petrographic study by the two geologists in the near future.

Professor **Martin** described a visit which he paid during the summer to the noted mineral locality at Haddam, Maine, and the manner in which the choicest specimens occur there, in veins of albitic pegmatite, with tourmaline, muscovite, and quartz along the contact with the wall of gneiss. The mica plates along the contact are often two feet in diameter.

Dr. **Julien** briefly reviewed the observations and opinions of Mitchell, Davis, Shaler, and others on the geology of Cape Ann, with especial reference to the district from Chatham to Yarmouth. In the stratified deposits of sands and gravels which underlie the plain south of the morainal "backbone" of the cape, the more frequent intercallation of clays was pointed out, and their occasional disturbance and flexure. Striated pebbles, although much water worn, are quite largely interspersed. The discovery of true glacial silt at some depth, in one locality, indicates that the ice sheet rested there, instead of floating. The kettle-shaped hollows and pond basins were shown by the speaker to be largely connected with the damming of surface streams, and some observations on the pre-glacial drainage valleys and topography were discussed. The identification of certain transported fragments of quartz-porphyry with outcrops of the same near Marblehead indicate a pre-glacial movement from N.N.W. to S.S.E. To the fifteen changes of level which have been recorded, a final small elevation probably should be added, judging from the low terrace along this part of the coast. Examples of the faceted pebbles were exhibited and provoked considerable discussion among those present, as to the origin of such pebbles.

Professor **Dodge** recounted his pleasure in visiting the region of the Grand Cañon, in company with a party during the past summer, and in finding the physiography so graphically illustrated in the drawings in Powell's reports to be a most faithful and non-diagrammatic portrayal of the features themselves. He then described the striking examples of gigantic geo-physical results seen in the Great Kaibab monocline. He also described the appearance of the great basin of "Lake Bonneville."

Remarks on foreign localities visited by them during the last summer were made by Professor **Stevenson** and Dr. **Hovey.**

THEODORE G. WHITE,
Secretary.

SECTION OF ANTHROPOLOGY AND PSYCHOLOGY.

OCTOBER 22, 1900.

Section met at 8:15 P. M., Prof. J. McK. Cattell presiding.

The evening was devoted to reports of summer work by Dr. **Franz Boas,** Dr. **Livingston Farrand,** Dr. **A. Hrdlicka,** Dr. **F. W. Putnam** and Prof. **R. E. Dodge.**

SUMMARY OF PAPERS.

The papers gave accounts of anthropological investigations made during the summer in the Vancouver Islands, Oregon, New Mexico, Arizona and California.

CHARLES H. JUDD,
Secretary.

BUSINESS MEETING.

NOVEMBER 5, 1900.

Academy met at 8:15 P. M., Professor Hallock presiding.

The minutes of the last business meeting were read and approved.

The Secretary reported from the Council as follows:

The appointment by the Council of Prof. Charles Lane Poor as Editor of the Academy publications, in place of Mr. van Ingen, resigned.

That the Council had voted to formulate a budget for the ensuing fiscal year, and to recommend to the succeeding Council that there be no annual reception in 1901.

The following candidates for resident membership, approved by the Council, were duly elected: Prof. Charles Lane Poor, 4 East 48th street; Riccardo Bertelli, 409–415 Forsyth street.

RICHARD E. DODGE,
Recording Secretary.

SECTION OF ASTRONOMY, PHYSICS AND CHEMISTRY.

NOVEMBER 5, 1900.

Section met at 8:30 P. M., Prof. Wm. Hallock presiding.

The minutes of the last meeting of Section were read and approved.

The following program was offered:

F. L. Tufts, FLOW OF AIR AT DIFFERENT PRESSURES THROUGH GRANULAR MATERIALS.

SUMMARY OF PAPER.

The experiments described by Mr. **Tufts** were made in connection with others on the transmission of sound through the same materials. Three different materials were experimented on, composed of lead shot of three sizes, the diameters of the shot being respectively 4.37 mm., 2.79 mm., and 1.22 mm. The shot was placed in a tube and air was forced through at different pressures, the rate of flow of air being measured by a gas meter, and the pressure differences by a water manometer. It was found that for a given size of shot and a given pressure gradient, the rate of flow was independent of the length of the column of shot through which the air flowed. The rate of flow, however, in the three cases experimented with did not increase as rapidly as the pressure gradient. This was more noticeable with the coarse shot than with the finer. For pressure gradients of about 0.01 cm. water pressure per centimeter of length of material, the rate of flow through the coarsest shot was ten times the rate through the finest, while for a pressure gradient fifty times as great, the rate of flow was a little less than three times as great in the coarsest as in the finest. With each size of shot the space occupied by air was about 30 per cent. of the total space occupied by the shot.

Wm. S. Day,
Secretary.

SECTION OF BIOLOGY.

November 12, 1900.

Section met at 8:15 P. M., Prof. C. L. Bristol presiding.

The minutes of the last meeting of Section were read and approved.

The name of one candidate for resident membership was read and referred to the Council according to the By-Laws.

The following program was then offered:

F. C. Waite, The Bermuda Toad.

H. F. Osborn, The Phylogeny of the Rhinoceroses in Europe.

H. L. Clark, Further Notes on Bermuda Echinoderms.

Summary of Papers.

Bufo agua was introduced into the Bermudas from British Guiana about 1885, and is now common throughout the colony. This is the largest Anuran known, specimens 155 mm. in length having been taken in Bermuda. It breeds there in brackish marshes; elsewhere in fresh water pools. The spawning time in Bermuda is not known, but young were found in July.

Bermuda is the northern limit of its range, which includes many of the Lesser Antilles (introduced), southern Mexico, Central America, and South America south to Ecuador on the west coast, and to Argentina (38° S.) on the east coast.

There is a general belief that it is venomous. The secretion of its cutaneous glands causes ulceration of mucous membrane, and opaqueness of the cornea. Subcutaneous injections cause convulsions, followed by death in frog, fowls and dog.

During the discussion which followed, the facts were brought out that this toad is a clumsy animal, jumps high rather than far, and is very active at night. It is destructive to insects, and is a pest in Bermuda, where it attacks cats and dogs fatally.

Professor **Osborn** reported a continuation of his investigations upon the PHYLOGENY OF THE RHINOCEROSES OF EUROPE. These animals appear to fall under the law of early divergence, and to constitute at least six separate series or phyla which, so far as known at present, are not genetically related to each other, but undergo a more or less parallel development as follows: *Diceratheriinæ*, *Aceratheriinæ*, *Brachypodinæ*, *Ceratorhinæ*, *Atelodinæ*, *Rhinocerotinæ*. The chief criteria in distinguishing rhinoceroses are the proportions of the skull, whether dolichocephalic or brachycephalic, the proportions of the limb in reference to cursorial or aquatic habits and the position of the horns; subsidiary to these features are the types of tooth structure. The origin of the rhinoceroses is still obscure, although it appears to be possible to derive the *Diceratheriinæ* from certain Eocene Hyracodontidæ. This study will be published in full in the *Bulletin of the American Museum of Natural History*, and it constitutes a part of the continuation of the author's memoir on the extinct rhinoceroses.

Mr. H. L. **Clark's** paper was read by Professor C. L. Bristol. In this paper Mr. Clark gave an account of the Echinoderms collected by the party of zoölogists from the New York University in the summer of 1899, together with a summary of his own observations during April of that year. It is to be concluded from an abundance of observations that the distinctions hitherto thought to exist between *Stichopus diaboli* and *Acanthomela* are not to be regarded as valid, and the forms described under these names must be referred to *S. Mobii*. Twenty-nine species are listed.

Mr. **Waite** called attention to the fact that the madreporic body in *Asterias tenuispina* branches forming 1–4 bodies in each animal, thereby making orientation difficult.

FRANCIS E. LLOYD,
Secretary.

SECTION OF GEOLOGY AND MINERALOGY.

NOVEMBER 19, 1900.

Section met at 8:15 P. M., Dr. A. A. Julien presiding.

The following program was offered:

J. F. Kemp, RECENT PROGRESS IN INVESTIGATION OF THE GEOLOGY OF THE ADIRONDACK REGION. Illustrated with specimens and diagrams.

A. A. Julien, NOTES ON THE ORIGIN OF THE PEGMATITES FROM MANHATTAN ISLAND AND FROM NORTH CAROLINA. Illustrated with specimens and diagrams.

SUMMARY OF PAPERS.

Professor **Kemp** outlined the area of crystalline rocks in the northern part of New York State and illustrated its distribution by means of maps. Three principal classes of rocks are present. First, those certainly igneous in their nature, including the labradorite rocks, the basic gabbros and the trap dikes. Second, those certainly sedimentary, best illustrated by the crystalline limestones. Third, great areas of gneiss of uncertain origin. Regarding the first class, we now know quite accurately their distribution and the results obtained by the speaker, by H. P. Cushing and C. H. Smyth were briefly reviewed. A short description was given of the augite-syenite first discovered by Cushing near Loon Lake, but which has since been found to be widely distributed in the regions further south. Some notes were also given regarding the ages of the trap dikes and their distribution.

Recent additions to the knowledge of the sedimentary rocks, involve the recognition of quite large amounts of quartzites in a considerable number of new localities. Besides these, small beds of limestone have been discovered in the southern areas, especially in Warren and Washington counties, which are thoroughly interstratified with the gneisses and which leave no escape from concluding that the gneisses are also sedimentary in their origin and that a regularly stratified series of rocks is present.

This conclusion removes many of the gneisses from the group of uncertainties.

The speaker also briefly enumerated the discovery of new outliers of Cambrian and Ordovician strata in the midst of the crystallines; taking up the small but early discovered area at Wellstown, Hamilton county, he added some new and important facts and interpretations. He also noted the distribution of the glacial striations throughout the eastern mountains and noted their nearly uniform bearing to the northeast. In conclusion, he described the physiography as being due chiefly to a series of faulted blocks which afford a very characteristic saw-toothed sky-line.

Dr. **Julien** opened his paper with a discussion of several of the later theories of the origin of pegmatites in common acceptation. That of igneous intrusion, urged by Brögger, seems to cover facts which are not met with in the pegmatites of Manhattan Island, western Massachusetts nor western North Carolina. Brögger's theory and the pneumatolytic theory of Lehmann, Williams and Crosby, explain but imperfectly the most important occurrences of pegmatite occurrences in schists, especially evidences of their development *in loco*. Dr. Julien then summarized his own theory of metasomatic aggregation which he originally advanced at the meeting of the American Association for the Advancement of Science in June, 1900. In this he attributed the origin of the pegmatites of Manhattan Island entirely to molecular rearrangement of the material of the schists by the action of mineralizers in the vicinity of lamination planes and of fissures.

After a description of the main features of the pegmatites of Manhattan Island, with the help of specimens and diagrammatic drawings of outcrops and cross-sections, the speaker advanced the following chief conclusions:

1. The existence of a certain series of pegmatite development, at least two, but probably indefinite in number, marked by a succession of intersections. Of these the oldest is by far the most extensive, intercalated among the pliation-seams, and coincident with the strike. These pliation-seams cut the schists in

all directions and inclinations, but their courses are mostly comprised in the northeast quadrant. A few, which are gathered in partially concentric groups of curved planes, also present their convexity toward the northeast.

2. Every pegmatite occurrence on the Island, without exception, retains more or less structural evidence of having begun its existence as a vein, segregated from a magma or igneo-agueous emulsion. Even the notable dike near 205th Street, crossing the dolomite, retains the vein structure, perfectly in places and imperfectly throughout.

3. Contact-phenomena are confined mainly to the earlier alteration along seams, to projection of veinlets rather than intrusion apophyses, and, at one dolomite intersection, to a thin selvage of phlogopite and tremolite.

4. The vein-structure, often well preserved, presents distinct lamination, correspondent deposits on the two walls, comb-structure, passage from less to more acid minerals toward the centre, and final concentration of minerals of the rarer elements in association with the significant matrix, smoky quartz, along lenticular bands, often near a central suture.

5. Some of the most prominent features, and those by which the simplicity of the problem has been disguised, are the results of pressure upon the original veins through organic movements of the stratum of schists, viz., fissuring, faulting, crushing, shearing with development of mica (aptite), re-fusion and development of new phenocrysts (granite-porphyry), and generation of reaction borders outside of each wall of a vein. When flowage has taken place and some transference of the crushed vein material along the plane of the vein, the appearances of a dike begin. Many of these results may be distinguished along the course of the same vein at intervals of a few yards or rods, but in the most characteristic dikes the vein structure is rarely, if ever, completely obliterated.

Both of the papers presented were discussed by Professor **Martin**, Dr. **Hovey**, and others.

THEODORE G. WHITE,
Secretary.

SECTION OF ANTHROPOLOGY AND PSYCHOLOGY.

NOVEMBER 26, 1900.

Section met at 8:15 P. M., Prof. J. McK. Cattell presiding.

The minutes of the last meeting of Section was read and approved.

The name of one candidate for resident membership was read and referred to the Council according to the By-laws.

The following program was then offered :

R. S. Woodworth, PARIS CONGRESS OF PSYCHOLOGY.

Clark Wissler, CORRELATION OF ANTHROPOMETRIC TESTS.

E. L. Thorndike and **R. S. Woodworth,** EFFECTS OF SPECIAL TRAINING ON GENERAL ABILITY.

C. H. Judd, MOVEMENTS OF WRITING.

SUMMARY OF PAPERS.

The report of the Paris Congress presented by Dr. **Woodworth** was more detailed than the published accounts, and also suggested certain questions in regard to the enlargement and control of American representation at similar congresses in the future.

The paper by Mr. **Wissler** reported some results of a series of mental and physical tests upon students in Columbia and Barnard College. The young women of Barnard College were found to be superior to Columbia freshmen in the tests for time of perception, naming of colors and resistance to pressure ; they were equal to the freshmen in rate of fatigue, perception of weights, sensation areas, perception of size and logical memory ; they were inferior in size of head, strength of hand, reaction time, association time and auditory memory. There is some probability that the young women are superior in perception of pitch and inferior in movement time. With the freshmen who repeated the test in their senior year an improvement was found in all except sensation areas and perception of size, though the difference in some cases is slight. It was also found that the seniors showed a decided tendency to hold the same relative rank as when freshmen, thus indicating a general advancement of the group during college life. In correlations it appeared that logical memory and length of head are related characteristics, but length of head also correlates with lung capacity and strength of hand. The work has not gone far enough to say which of these has the most weight. Attempts to correlate reaction time and the other tests of quickness gave no results.

Dr. **Thorndike** presented the results of certain experiments on the Effects of Special Training on General Ability. These experiments were performed jointly by Drs. Woodworth and Thorndike. The results of a number of experiments show that when any mental function is trained in connection with certain data, the improvement is not of the function in general. If different data are used there will be less or even no improvement shown. The general theory that the mind equals a number of special abilities, independent to a degree hitherto unsuspected, was supported further by the great variability in our judgments of slightly differing magnitudes.

The fourth paper was on the Movements of Writing. These movements were analyzed by means of tracers attached to the hand, back of the fingers, and to the arm, back of the wrist. The written words give the sum of all the movements of arm, hand, and fingers. The hand tracer gives only arm and hand movements, omitting finger movements. The arm tracer shows arm movements only. The general result of this analysis shows that the arm carries the hand forward and participates only to a very small degree in the formation of the letters and words. The gross movements, especially those which are upward and forward, in the formation of the letters, are performed by the hand. All the finer curves and more delicate lines of the letters are formed by the fingers. The muscular coördinations of the different individuals tested, while differing greatly in detail characteristics, all show this general type of movement. No results were presented from subjects who write naturally with a full arm movement.

Charles H. Judd,
Secretary.

BUSINESS MEETING.

December 3, 1900.

Academy met at 8:15 P. M., Professor Wm. Hallock presiding.

The minutes of the last business meeting were read and approved.

The Secretary reported from the Council as follows:

That Professor Poor had taken active charge of the editorial work of the Academy; also that the Council had appointed a committee to secure, if possible, a publication fund.

The following Candidates for resident membership, approved by the Council, were duly elected:

O. P. Hay, American Museum of Natural History.
E. O. Hovey, American Museum of Natural History.
(Dr. Hovey to become a life member.)

Richard E. Dodge,
Recording Secretary.

ASTRONOMY, PHYSICS AND CHEMISTRY.

December 3, 1900.

Section met at 8:20 P. M., Professor William Hallock presiding.

The minutes of the last meeting of Section were read and approved.

The following program was offered:

E. R. von Nardroff, Determination of the Wave Length of Sound by the Grating Method. (Illustrated.)

W. G. Levison, A Method of Photographing the Entire Corona on One Plate, Employed at Newberry, S. C., for the Total Solar Eclipse of May 23, 1900. (Illustrated.)

W. G. Levison, The Action of Canada Balsam on Photographic Gelatine Plates.

Summary of Papers.

As a source of sound the author of the first paper used a miniature steam whistle made of brass and operated by a current of air from a tank of compressed air. The sound produced in this way was inaudible on account of its high pitch, the wave length being only about three-eighths of an inch. The whistle was placed at one of the conjugate foci of a parabolic metallic mirror, a sensitive flame being placed at the other conjugate focus. A transmission grating made of wood and resembling somewhat a portion of a picket fence was then interposed in the path of the reflected sound waves, and it was found that when the sensitive flame was shifted to one side, as many as four positions of maximum effect were obtained on each side of the central beam of sound. With this apparatus, the wave length of sound, when the waves were short like those used, could be measured within one per cent.

Mr. **Levison's** method consisted in the use of a specially constructed color screen most dense at the centre and fading off to clear glass at the edges, which was placed close to the photographic plate. The size and density of the screen was adjusted as nearly as possible so that the image of the inner corona made by a suitable lens fell on the part of the plate covered by the screen while the image of the outer corona passed through the clear glass. The color screen was made from a lens of colored glass with sharp edges, which was cemented into a recess in a plate of clear glass ground to receive it. Two screens were made, one of orange-yellow glass and one of dark greenish-blue glass. In testing these screens at the time of the eclipse, an arrangement of telephoto-lenses was used, but unfortunately the exposure was not long enough to give any image at all of the outer corona through the clear glass, although a considerable impression of the inner corona was produced through the orange-yellow glass, but none through the bluish-green glass. This should give some idea of the relative actinometric intensity of the light from the inner and from the outer corona.

Mr. **Levison** also presented a short note on the action of Canada balsam on photographic plates. In making the experiments with color screens he noticed that Canada balsam that had been baked hard, when placed in contact with a sensitive plate, or separated from it by a layer of carefully selected black paper and allowed to remain a week or more, affected the plate in the same manner as light, the part affected developing black. He verified this effect by a number of experiments. In the author's opinion, this effect seemed likely to be caused by true Becquerel rays, as it passed through the black paper which is perfectly opaque to ordinary light.

William S. Day,
Secretary.

SECTION OF BIOLOGY.

December 10, 1900.

Section met at 8:15 p. m., Professor C. L. Bristol presiding.

The minutes of the last meeting of Section were read and approved.

Professor **Lloyd** offered his resignation as Secretary of the Section, because he is soon to leave for Europe on a leave of absence from Teachers College. On the motion of Professor Wilson, seconded by Dr. Calkins, a vote of thanks was tendered to the secretary for his interest in furthering the work of the Section.

The following program was then offered:

G. N. Calkins, Some Interesting Protozoa from Van Cortlandt Park.

H. E. Crampton, Elimination in Lepidoptera.

E. B. Wilson, The Chemical Fertilization of Sea-Urchin Eggs.

Summary of Papers.

Four genera of Protozoa which are usually regarded as intermediate forms between the classes of Protozoa were considered. These were: *Nuclearia*, intermediate between the Rhizopoda and the Heliozoa; *Mastigomœba*, intermediate between Mastigophora and the Rhizopoda; *Multicilia*, intermediate between the Mastigophora and Ciliata, and *Actinobolus*, intermediate between the Ciliata and the Suctoria. The method of feeding in the latter form was also described for the first time. All of these forms, together with 54 other genera and a great many species (100 to 150) were found in the waters of Van Cortlandt Park during the past fall.

The second paper was designed to be the first of a series dealing with the problems of variation and selection in Lepidoptera, and especially in the Saturnid moths. The particular questions here considered are as to the relative variability of eliminated and surviving pupæ and moths of *Philosamia cynthia*, and as to the relative variability of males and females. From a lot of 1,090 cocoons from a restricted locality, 310 living and 632 dead pupæ were obtained, the remainder being shrivelled or abnormal larvæ and pupæ. The living pupæ were compared with an equal number of dead pupæ with reference to certain body-characters (length, length of bust, width, depth, frontal stature and sagittal stature of bust), and to certain characters of a typical organ, the left antenna (length, breadth and stature). It appears that the surviving males are slightly less variable than the eliminated males, and that the surviving females are far less variable. From the living pupæ but 180 perfect moths were obtained. The males were from pupæ which were far less variable than pupæ producing abnormal moths; but the females were from relatively more variable pupæ, though the latter were much less variable than eliminated female pupæ of the preceding group. The paper will be published in full.

Professor **Wilson** presented the results of a study of the phenomena of development in the unfertilized eggs of *Toxopneustes* when treated with solutions of magnesium chloride by Loeb's method. The results confirm Loeb's conclusion that the embryos arising from these eggs are produced without fertilization by spermatozoa, conclusive proof being given in the fact that during cleavage the number of chromosomes is half the usual number, namely, 18 instead of 36. The mitotic phenomena differ in many details from those occurring in fertilized eggs, but show a striking general parallelism to them. The asters may be only two in number (cleavage asters), but as a rule there are many other asters (cytasters) that have no connection with the nucleus. Like the nuclear asters, however, the cytasters contain centrosomes and may progressively multiply by division. Cytasters and centrosomes are formed also in enucleated fragments obtained by shaking unfertilized eggs to pieces before treatment by the magnesium solution, and these asters may likewise multiply by division.

These facts seem to leave no doubt of the formation of functional centrosomes *de novo* and independently of the nucleus. Evidence was adduced to show that the asters may operate as centres of cytoplasmic division, independently of the nucleus. It was also shown that the magnesium eggs show numerous gradation in the mitotic process between complete division and partial mitosis.

FRANCIS E. LLOYD,
Secretary.

GEOLOGY AND MINERALOGY.

DECEMBER 17, 1900.

Section met at 8:15 P. M., Dr. A. A. Julien presiding.

The minutes of the last meeting of Section were read and approved.

The following program was offered:

E. O. Hovey, EXHIBITION OF LANTERN SLIDES ILLUSTRATING SOME OF THE QUARTERNARY DEPOSITS OF THE HUDSON RIVER VALLEY, AND SOME MISCELLANEOUS SUBJECTS.

D. S. Martin, NOTES ON THE GEOLOGY AND MINERALOGY OF THE VICINITY OF BALTIMORE, MARYLAND.

W. G. Levison, MINERALS FROM THE JONES' FALL QUARRIES, NEAR BALTIMORE, MARYLAND.

SUMMARY OF PAPERS.

Dr. **E. O. Hovey** exhibited several series of slides on geological subjects recently prepared by him for Professor Bickmore. The first series illustrated the clay deposits of the Hudson River Valley, and the process of manufacturing those clays into bricks; the second series comprised the outcrops of the Cortland series of rocks along the Hudson, the included schists, and the Tompkins Cove Limestone quarries. The third series illustrated the character of the sand dunes of Newburyport and Plum Island,—the dissected drumlin at Great Boar's Head, New Hampshire, and the gneissoid granite with dikes at Isle of Shoals.

The slides were further discussed by Professor Kemp, Dr. Julien, and Dr. Levison.

Professor **Martin** discussed the geology of the Jones' Falls valley, north of Baltimore, Md. The rocks are principally white hornblendic gneiss, cut by pegmatite dikes,—the latter containing many minerals. The crystallines decomposed with great rapidity, forming a reddish soil. Professor Martin also commented on the excellent museum of local geology maintained by the Maryland Academy of Sciences, which illustrates all the formations of the State from the base of the Archean to the Catskill. The use of the term Catskill in describing the rocks called by that name in Maryland was called to question, and was discussed by Drs. Call, Hovey, Julien, Kemp, White, and Professor Stevenson, the latter defining the Catskill as a condition arising at the closing period of the Chemung in certain localities, and not marked by characteristic fossils nor worthy of a position as a division of the geological time scale.

Dr. **Levison** exhibited a number of minerals from the pegmatitic development in the Jones' Falls quarries near Baltimore, Md. Among them were albite, laumontite, garnet, epidote, thulite, and zoisite.

The meeting adjourned at 10 P. M.

THEODORE G. WHITE,
Secretary.

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